Spotter Training 2016

All photos courtesy of the KCCI uLocal page or Twitter

Outline

Part I

- Introduction
- Being a Storm Spotter
- Spotter Safety
- 2015 Iowa Weather Review
- Iowa Severe Weather Climatology

Break

Part II (Optional)

- Thunderstorm Fundamentals
- Updrafts & Downdrafts
- Tornadoes
- Quiz

Source Unknown

Courtesy CBS News

The National Weather Service

Who we Are…

Federal government weather forecast agency

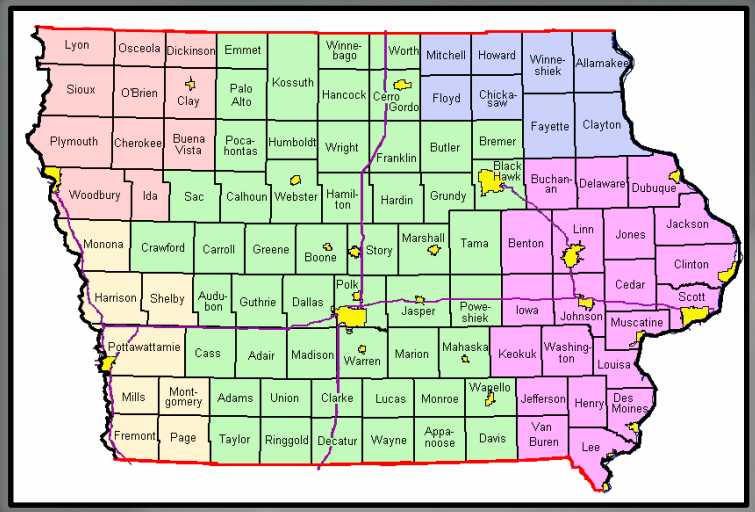
Who we Serve…

- United States & Territories
- Five Offices Serve Iowa

Primary Mission…

Provide weather warnings for the protection of life and property

As a spotter, you help us accomplish this mission!

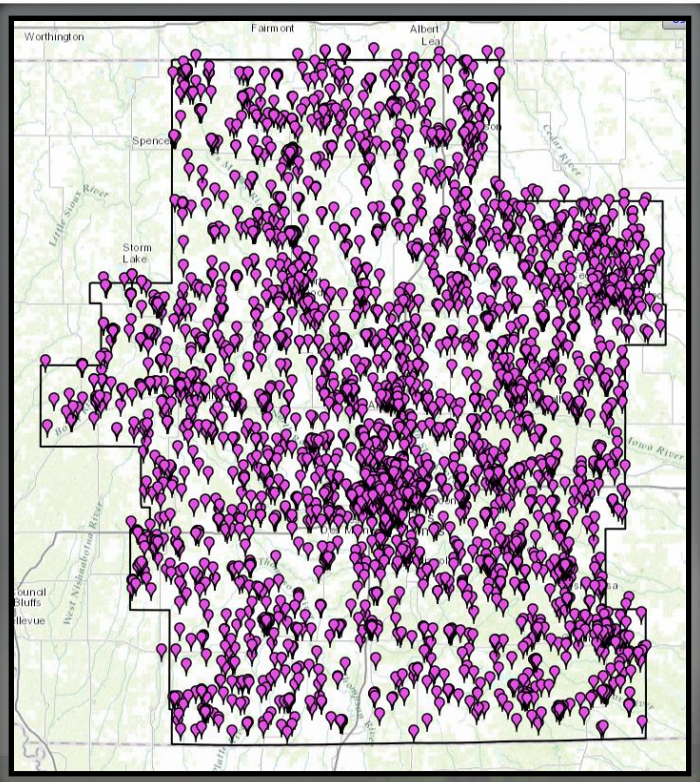


The Role of the Spotter

- Your reports are used in real-time to help meteorologists issue warnings
- Radar has many limitations; your reports provide vital ground truth
- Spotter reports are immediately released to the world to increase the response to the threat

We need **your** help to save lives and protect property!

The NWS Spotter Network



- Over 4,500 spotters and counting
- Contact the NWS directly with severe weather reports
- Spotters especially needed in rural areas

Interested in joining?
Register here or online!

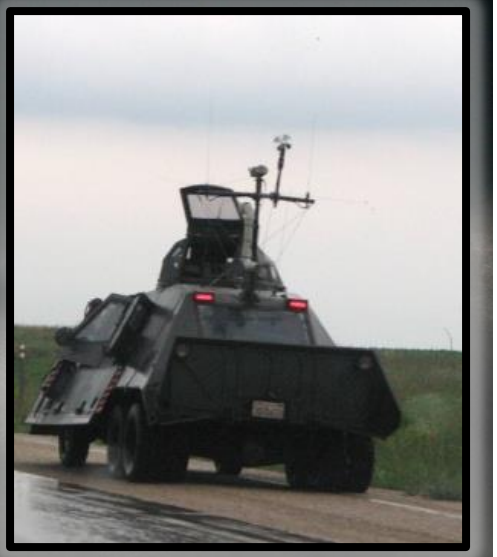
Other Types of Spotters

Local Fire/Police

Often report severe weather to dispatch, who then relays the report to the NWS.

Amateur Radio

Can be part of a net or independent.
Call sign for NWS Des Moines is **KØDMX**.



Storm Chasers

Cover large areas and chase for a hobby. Can send out video/photos in real-time online.

How to Report to the NWS

- **1-800-SKYWARN**
  Available for *ALL* spotters, dispatch centers and EOCs
- **Amateur Radio (KØDMX)**
  Amateur radio operators only
- **Social Media**
  Facebook and Twitter
- **Text Messaging**
- **E-mail**
- **Online Reporting Form**

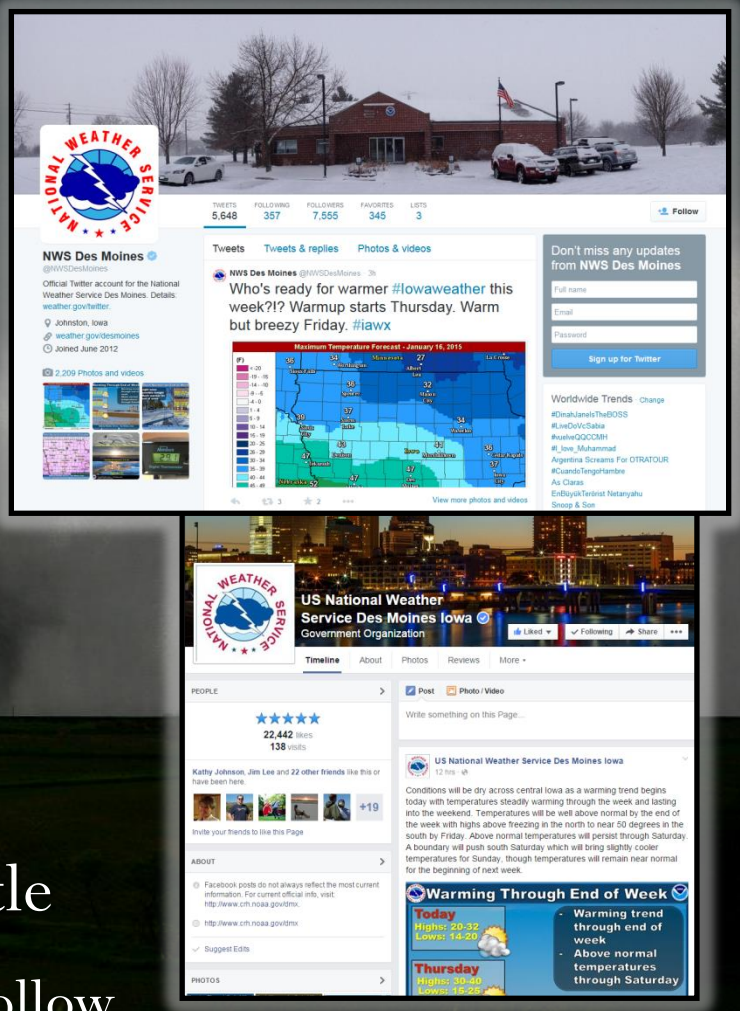
Courtesy Extreme Instability

Courtesy Extreme Instability

Social Media

How to Report to the NWS

- **Facebook** (NWS Des Moines)
  - Post reports, photos & videos directly on our page
  - Include your location & time!
- **Twitter** (@NWSDesMoines)
  - Send reports directly to us
  - Add #nwsdmx or #iawx
- **Periscope** (NWS Des Moines)
  - Send to Twitter with #nwsdmx or #iawx added to broadcast title

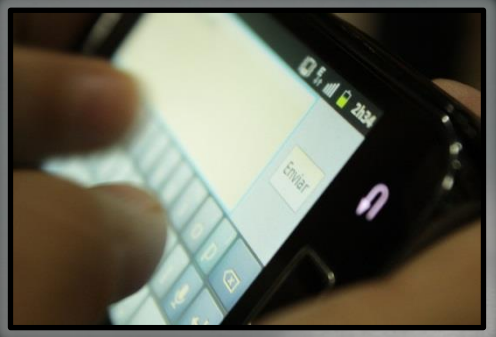


We encourage <u>everyone</u> to like and follow the NWS on Facebook and Twitter!

Text Messaging and Email

How to Report to the NWS

- **Text Messaging**
  (515) 240-5515



- **E-mail**
  dmx.spotterreport@noaa.gov
  Great for pictures and video

Remember!

Include the **time**, **date**, and **location** of severe weather with your report

Online Reporting Form

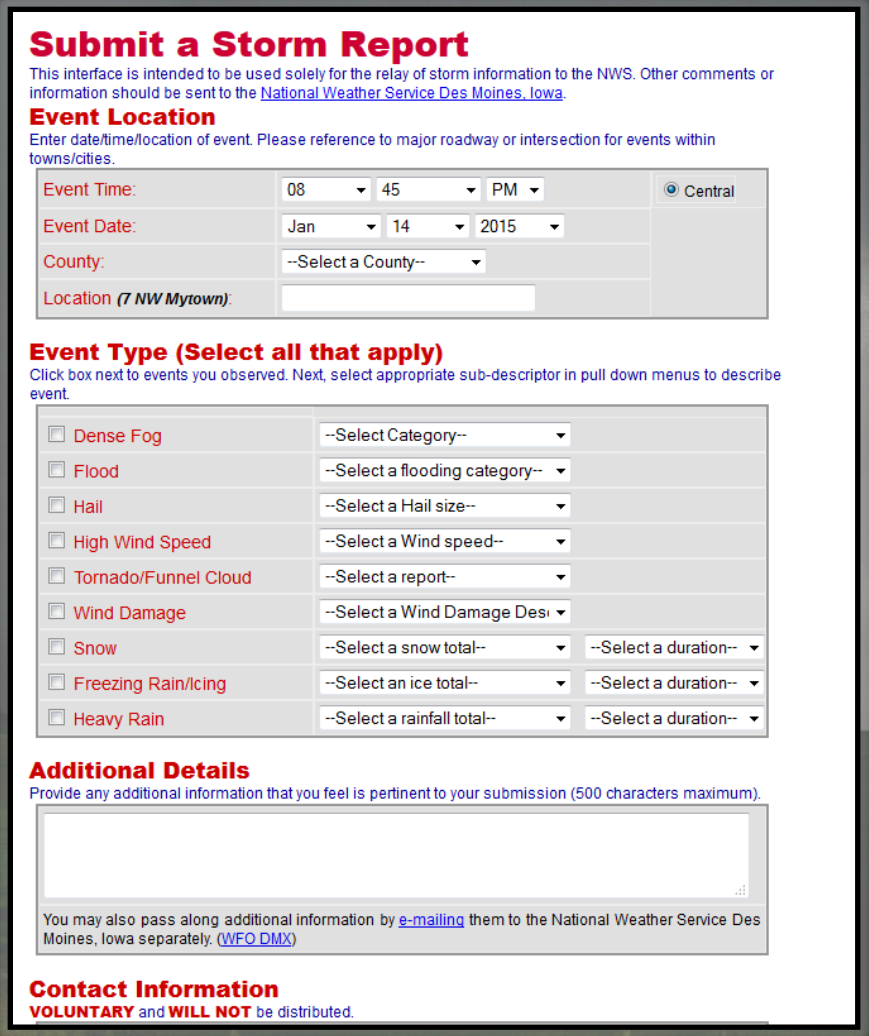
How to Report to the NWS

This form is available on our website at:

weather.gov/desmoines

Click "Submit Report" on the left hand column and then select the online form link

The form will guide you on what information to report



Submit a Storm Report

This interface is intended to be used solely for the relay of storm information to the NWS. Other comments or information should be sent to the National Weather Service Des Moines, Iowa.

Event Location

Enter date/time/location of event. Please reference to major roadway or intersection for events within towns/cities.

Event Time:	08 45 PM	Central
Event Date:	Jan 14 2015	
County:	--Select a County--	
Location *(7 NW Mytown)*:		

Event Type (Select all that apply)

Click box next to events you observed. Next, select appropriate sub-descriptor in pull down menus to describe event.

Dense Fog	--Select Category--	
Flood	--Select a flooding category--	
Hail	--Select a Hail size--	
High Wind Speed	--Select a Wind speed--	
Tornado/Funnel Cloud	--Select a report--	
Wind Damage	--Select a Wind Damage Des	
Snow	--Select a snow total--	--Select a duration--
Freezing Rain/Icing	--Select an ice total--	--Select a duration--
Heavy Rain	--Select a rainfall total--	--Select a duration--

Additional Details

Provide any additional information that you feel is pertinent to your submission (500 characters maximum).

You may also pass along additional information by e-mailing them to the National Weather Service Des Moines, Iowa separately. (WFO DMX)

Contact Information

VOLUNTARY and **WILL NOT** be distributed.

What to Report

Who?	Spotter number/source
What?	What are you seeing? Use proper terms
Where?	Reference the nearest city, street, or lat./lon.
When?	Time of event (if in the past)
Damage?	Be descriptive

Be as specific as possible!

Include all of the above information in your reports regardless of the reporting method

Tornadoes

What to Report

- **Rotating Wall Clouds**
- **Funnel Clouds**
  - How far down to the ground?
- **Tornadoes**
  - Can you see rotation in the cloud?
  - Any dust or debris below the funnel?
  - How far away is tornado?
    (estimate the distance and direction)
  - Speed & motion of the tornado?
  - Size of the tornado? Is it changing?
    (getting larger, roping out, etc.)
  - Damage, injuries, or deaths?

Hail

What to Report

Report all hail, regardless of size

- Measure the **diameter** of the hailstone
- If you can't measure the hail, compare to common coin or ball sizes
  - **Do not report marble-sized hail!**
- Report the size of the largest hailstone you measure (and the average size if possible)

Courtesy Jessica Varno

What Size are Your Marbles?

Diameter	Description
1/4"	Pea
1/2"	Dime
3/4"	Penny
1"	Quarter
1.25"	Half Dollar
1.50"	Ping Pong

Diameter	Description
1.75"	Golf Ball
2"	Hen Egg
2.50"	Tennis Ball
2.75"	Baseball
3"	Tea Cup
4"	Grapefruit

Damaging Winds

What to Report

- Wind Strength
  - Measured or estimate
- Tree damage
  - Size of tree limbs snapped off
  - How widespread is the damage?
  - Trees trunks snapped or uprooted?
  - Was the tree old or rotten?
- Building damage
  - Due to wind or trees falling onto the building?
- How long did the winds last?
- What direction was the debris blown?
  - Debris all blown the same direction?

Photos Courtesy
KCCI uLocal

Flash Flooding

What to Report

- What is being impacted?
  - Roads, houses, farm fields, etc.
- Water Depth? (estimate)
- Is the water standing still or flowing?
- How often does this location flood?
- How much rain has fallen at your place during the storm?
  - How quickly did the rain fall?

What to Report

Communication is Vital !

- Do you know how your report will reach the NWS in real-time?
- Your report can make a significant difference and it may save lives

Warning!

Do not report output from radar sources or warning text as a fact

Ex: Radar or a warning suggests there is golf ball size hail with a storm. Do not report this hail size unless it is actually observed.

What to Report

Can't remember all of this?

Don't Worry!

Reporting Severe Weather

Reporting severe weather is essential! Remember that each report, regardless of the method, must include the time and location of the event. Pictures tell a thousand words, but not when and where the weather occurred!

How to Report:

Online: Use our online weather reporting form! *For reporting tornadoes, please use our 1-800-SKYWARN telephone line.*

Email: dmx.spotterreport@noaa.gov - A great way to include pictures and/or video.

SMS Text Messaging: (515) 240-5515 - Send your phone pictures and text messages to this number with time, date, and location information. With pictures, include a bit of text describing the direction you are looking.

Telephone: 1 (800) SKYWARN - Must have been through severe weather spotter training and belong to a spotter network to use this line! Refer to materials received during spotter training.

Facebook: Visit our Facebook page and post a severe weather report to our wall.

Twitter - Send Twitter reports to the National Weather Service by including the #iawx hashtag.

Amateur Radio – The National Weather Service group amateur radio call-sign is *KØDMX*.

All of this information is on our handout or at weather.gov/desmoines on the **Storm Spotting** menu link

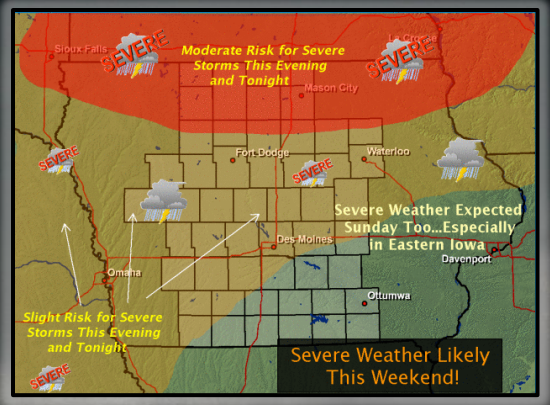
Days Ahead of the Event

Staying Informed

Weather Story

www.weather.gov/desmoines

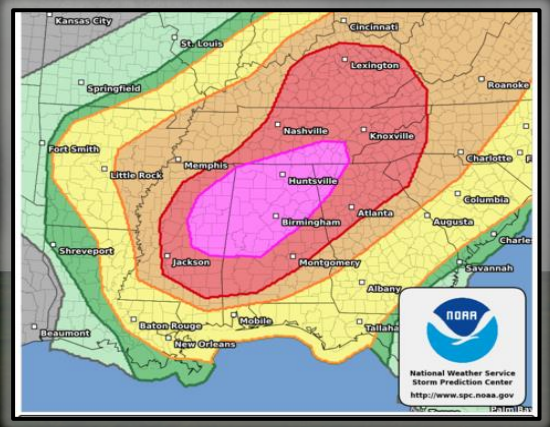
Highlights the most significant weather in the next few days in central Iowa



Severe Weather Outlooks

www.spc.noaa.gov

National outlooks issued by the SPC for the upcoming three days



None | Gen Storms | Marginal | Slight | Enhanced | Moderate | High

Replaces "See Text" — Added in 2015

Risk for Severe Weather

Days Ahead of the Event

Staying Informed

Understanding Severe Thunderstorm Risk Categories

THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
No severe* thunderstorms expected	**Isolated severe thunderstorms possible**	**Scattered severe storms possible**	**Numerous severe storms possible**	**Widespread severe storms likely**	**Widespread severe storms expected**
Lightning/flooding threats exist with <u>all</u> thunderstorms	Limited in duration and/or coverage and/or intensity	Short-lived and/or not widespread, isolated intense storms possible	More persistent and/or widespread, a few intense	Long-lived, widespread and intense	Long-lived, very widespread and particularly intense
					
• *Winds to 40 mph* • *Small hail*	• *Winds 40-60 mph* • *Hail up to 1”* • *Low tornado risk*	• *One or two tornadoes* • *Reports of strong winds/wind damage* • *Hail ~1”, isolated 2”*	• *A few tornadoes* • *Several reports of wind damage* • *Damaging hail, 1 - 2”*	• *Strong tornadoes* • *Widespread wind damage* • *Destructive hail, 2” +*	• *Tornado outbreak* • *Derecho*

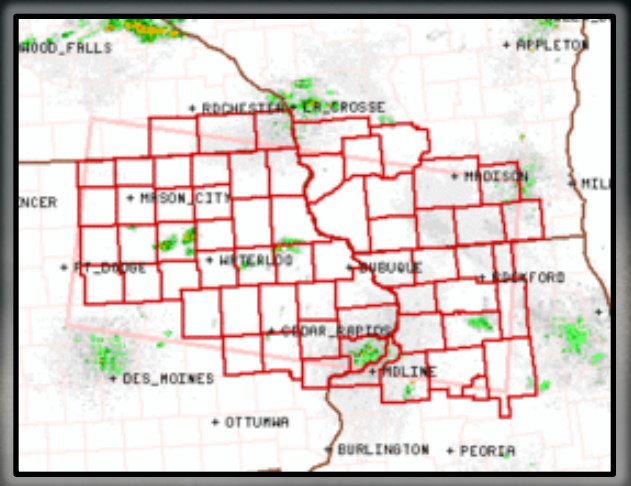
* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.

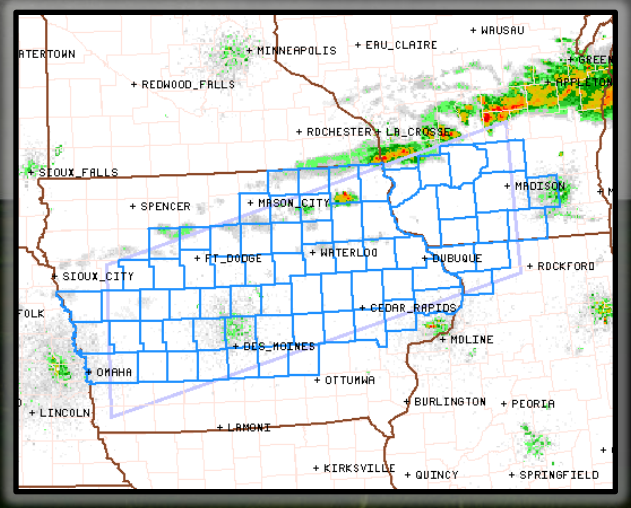
Severe Weather Watches

Staying Informed

Watch the Skies

- Issued when ***conditions are favorable*** for the development of severe weather
- In effect for 4 to 6 hours and cover large areas of the state





Types of Watches:

Tornado Watch

Severe Thunderstorm Watch

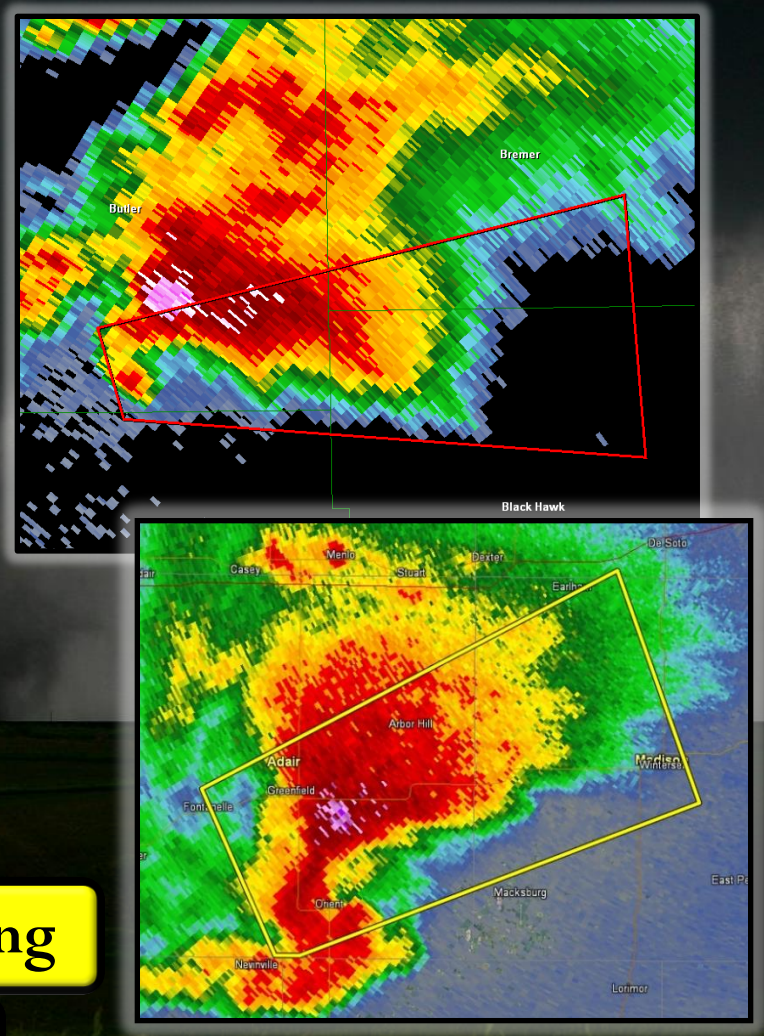
Flash Flood Watch

Severe Weather Warnings

Staying Informed

Take Action Now!

- Means severe weather is occurring or expect to occur very shortly
- Seek shelter now!
- The warning polygon is issued for the specific storm or threat



Types of Warnings:

Tornado Warning

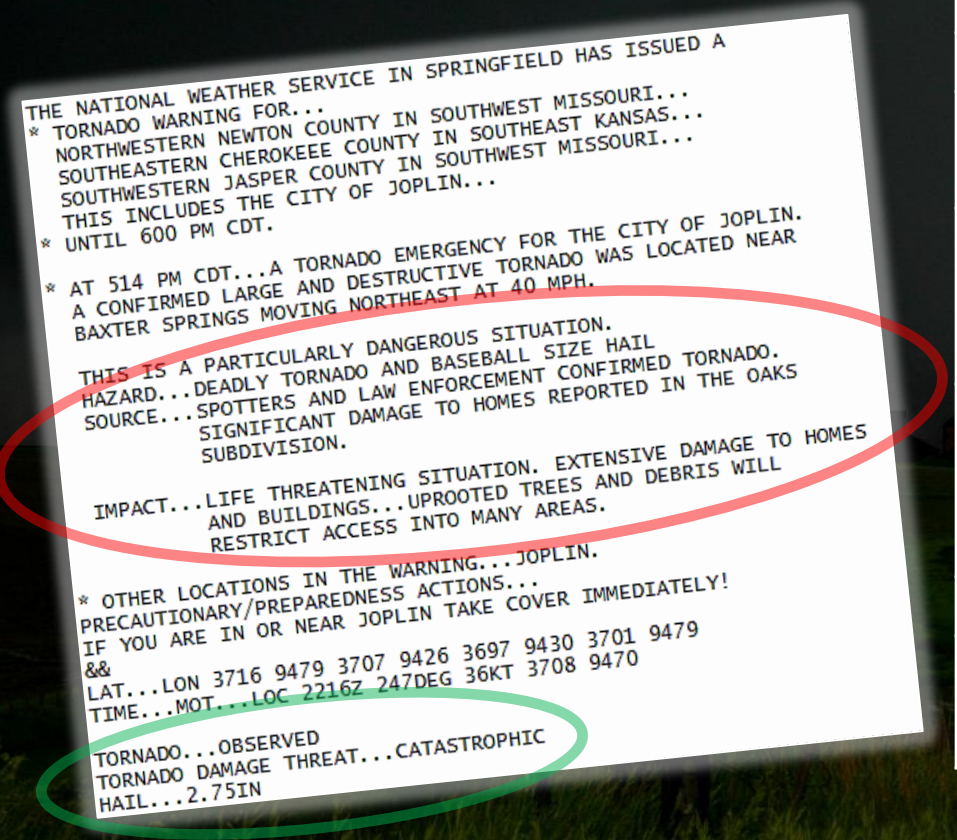
Severe Thunderstorm Warning

Flash Flood Warning

Severe Weather Warning Text

Staying Informed

Warning text describes impacts and uses "tags" to make important information easier to find



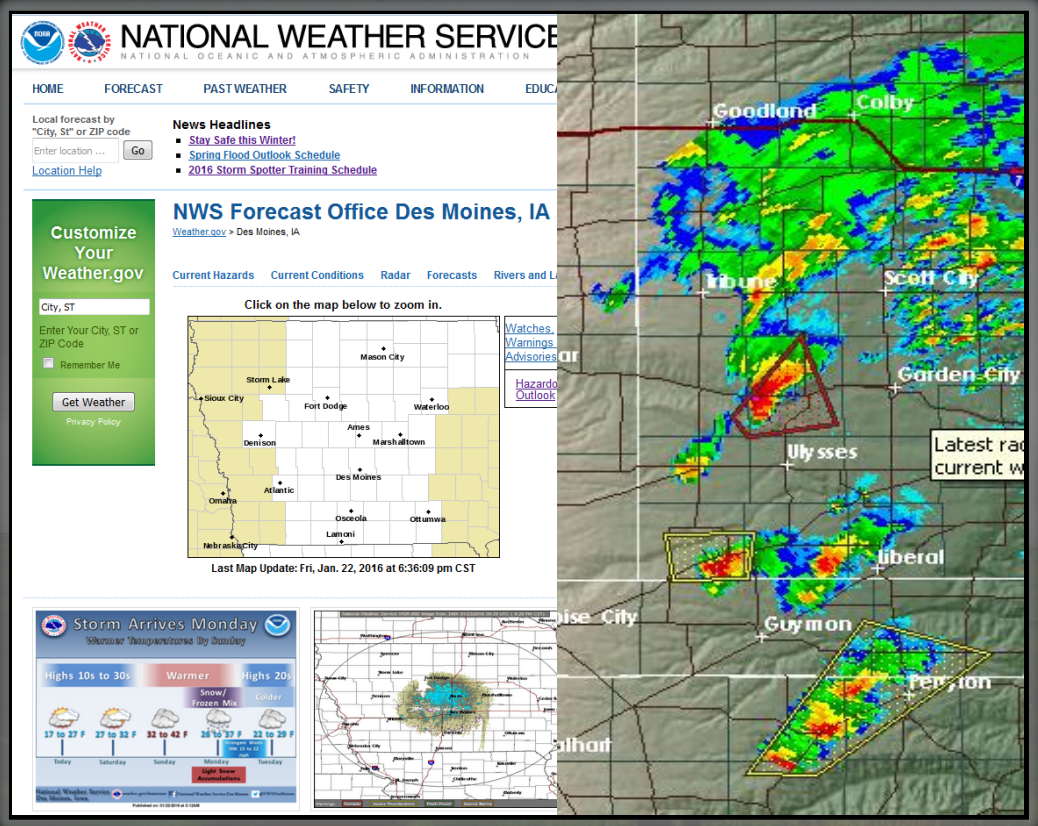
```
THE NATIONAL WEATHER SERVICE IN SPRINGFIELD HAS ISSUED A
* TORNADO WARNING FOR...
  NORTHWESTERN NEWTON COUNTY IN SOUTHWEST MISSOURI...
  SOUTHEASTERN CHEROKEEE COUNTY IN SOUTHEAST KANSAS...
  SOUTHWESTERN JASPER COUNTY IN SOUTHWEST MISSOURI...
  THIS INCLUDES THE CITY OF JOPLIN...
* UNTIL 600 PM CDT.

* AT 514 PM CDT...A TORNADO EMERGENCY FOR THE CITY OF JOPLIN.
  A CONFIRMED LARGE AND DESTRUCTIVE TORNADO WAS LOCATED NEAR
  BAXTER SPRINGS MOVING NORTHEAST AT 40 MPH.

  THIS IS A PARTICULARLY DANGEROUS SITUATION.
  HAZARD...DEADLY TORNADO AND BASEBALL SIZE HAIL
  SOURCE...SPOTTERS AND LAW ENFORCEMENT CONFIRMED TORNADO.
          SIGNIFICANT DAMAGE TO HOMES REPORTED IN THE OAKS
          SUBDIVISION.

  IMPACT...LIFE THREATENING SITUATION. EXTENSIVE DAMAGE TO HOMES
           AND BUILDINGS...UPROOTED TREES AND DEBRIS WILL
           RESTRICT ACCESS INTO MANY AREAS.

* OTHER LOCATIONS IN THE WARNING...JOPLIN.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
IF YOU ARE IN OR NEAR JOPLIN TAKE COVER IMMEDIATELY!
&&
LAT...LON 3716 9479 3707 9426 3697 9430 3701 9479
TIME...MOT...LOC 2216Z 247DEG 36KT 3708 9470

TORNADO...OBSERVED
TORNADO DAMAGE THREAT...CATASTROPHIC
HAIL...2.75IN
```

Tornado Warning Tag	
TORNADO...RADAR INDICATED	Evidence on radar is supportive of a tornado, but there is no ground confirmation.
TORNADO...OBSERVED	Tornado is confirmed by spotters, law enforcement, etc.
Tornado Warning Damage Threat Tag	
No Tag	Used most of the time when tornado damage is possible.
TORNADO DAMAGE THREAT...CONSIDERABLE	Used rarely when there is credible evidence that a tornado is capable of producing considerable damage.
TORNADO DAMAGE THREAT...CATASTROPHIC	Used exceedingly rarely when a severe threat to human life and catastrophic damage from a tornado is occurring.
Tornado Tag In Severe Thunderstorm Warnings	
TORNADO...POSSIBLE	A severe thunderstorm has some potential to produce a tornado

National Weather Service Website

Staying Informed

www.weather.gov/desmoines



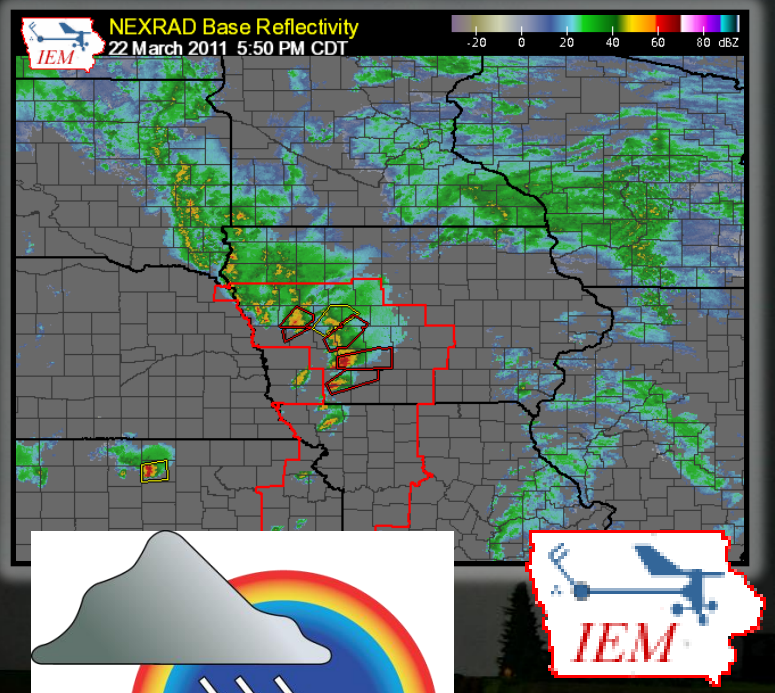
"One Stop Shop"

- Access to all outlooks, watches, and warnings
- Submit spotter reports
- Can view radar data with warning polygons
- Seven day forecast

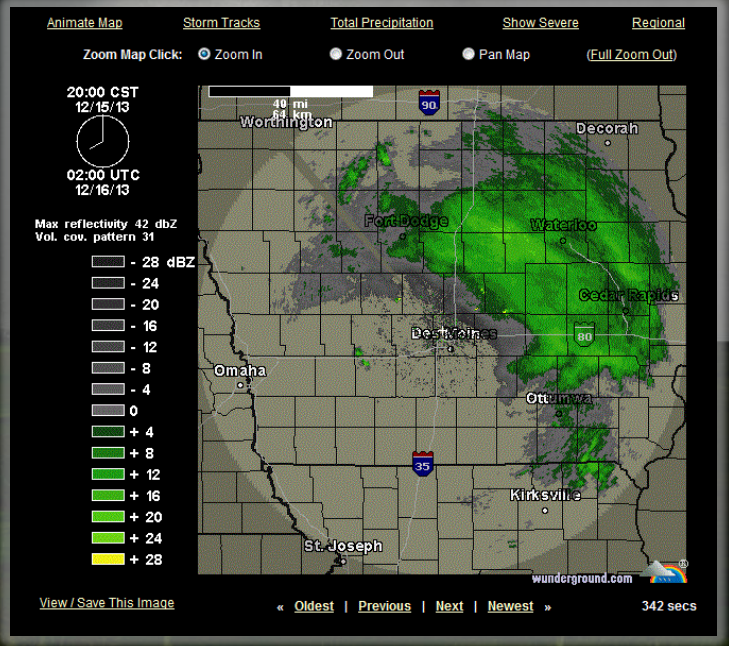
…and much more

Third Party Websites

Staying Informed



Dozens of third party sites that display warning and radar information



wunderground.com

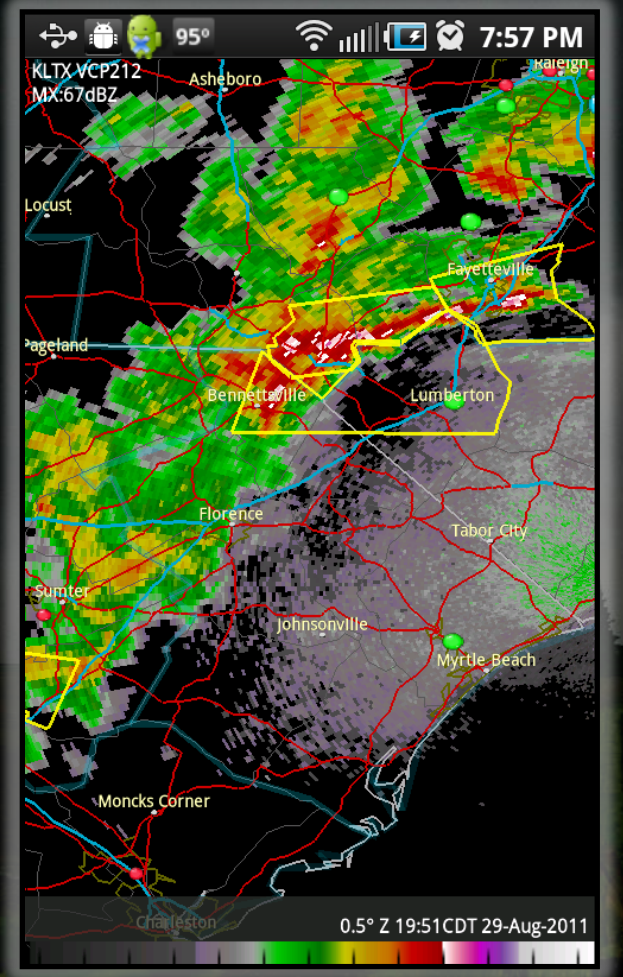
IEM

AccuWeather.com

The Weather Channel

Smartphone Apps

Staying Informed

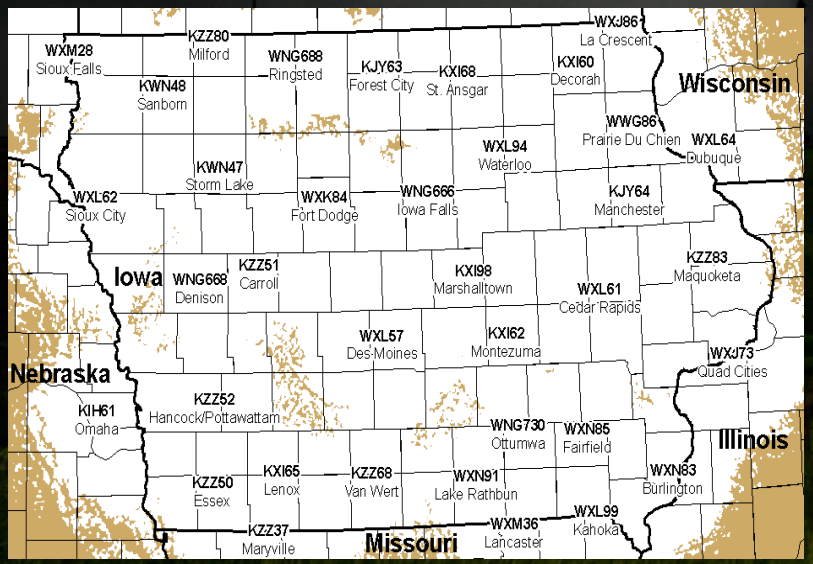


- Many apps available that provide current conditions, weather forecasts, radar data, and warnings for your location
- **Wireless Emergency Alerts (WEA)**
  - ➢ Tornado and flash flood warnings
- Several powerful radar apps:
  - RadarScope – iPhone and Android
  - PYKL3 – Android only

NOAA Weather Radio

Staying Informed

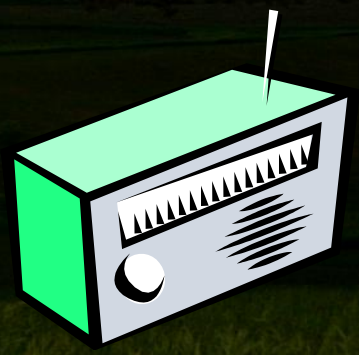
- Operated by the NWS and broadcasts weather forecasts and warnings 24/7
- Coverage over most of Iowa
- Need a special radio receiver
- Can program the radio to only alert for certain counties



Television and Radio

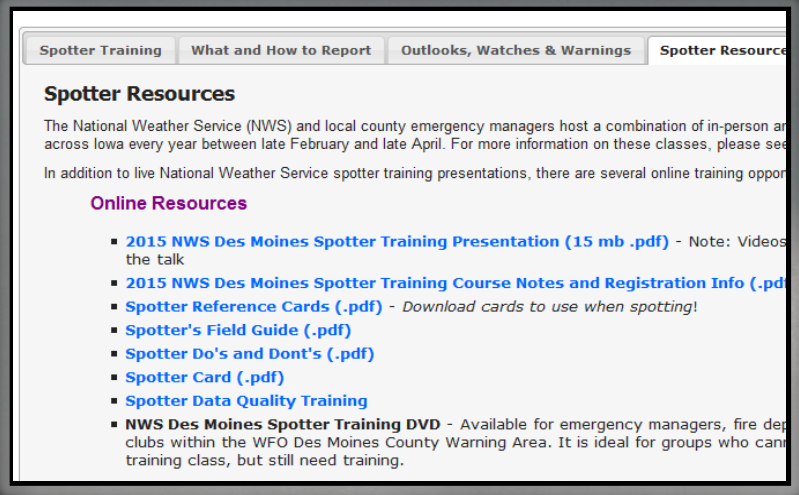
Staying Informed

- Radio stations will interrupt their programming to broadcast watches and warnings
- TV stations usually place a crawl at the bottom of the screen with the watch/warning information
  - Often will interrupt programming if the storm is heading towards a highly populated area



Additional Resources

- Online Spotter Resource Page
  See handout- online courses and excellent printable spotter guides
- Advanced Spotter Training
  Ready for the next step? Advanced spotter training will take place in March/April. Details to be announced soon.
- Spotter Webinars
  Regular & advanced classes offered online. See our website for details.



Spotter Safety

Tornadoes

Lightning

Strong Winds

Hail

Flash Flooding

Tornadoes

Spotter Safety

Courtesy Severe Studios, Inc

- **Maintain situational awareness at <u>ALL</u> times**
  - Avoid "tunnel vision"
- **<u>ALWAYS</u>** have an escape route
- Seek a sturdy structure if you are in danger
- Avoid night spotting
  - Hard to see anything
  - Very dangerous!
- If your car is struck by even a weak tornado, your life is in danger!

Tornadoes – Night Spotting

Spotter Safety

Source Unknown

Tornadoes – Vehicle Safety

Spotter Safety

Cars, trucks & SUVS are NOT safe!

Underpasses are NOT safe!

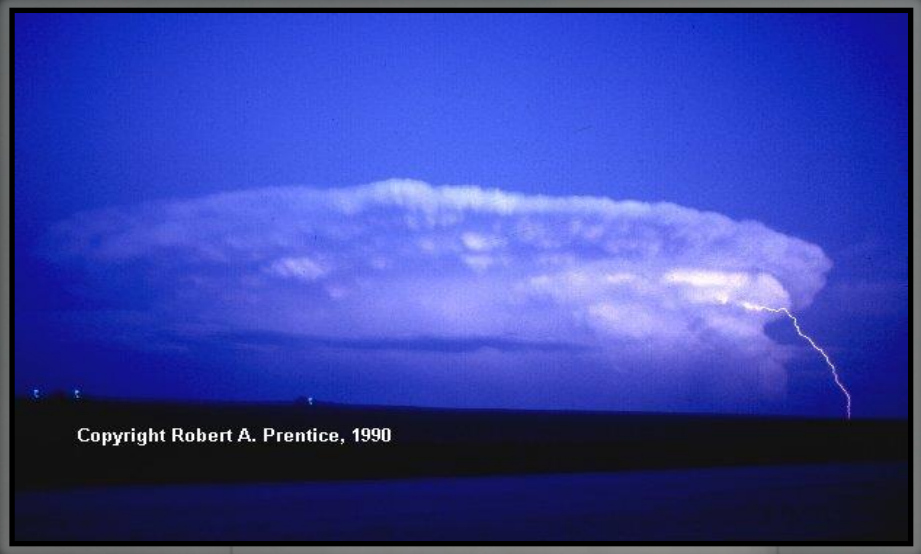
Tornadoes – Vehicle Safety

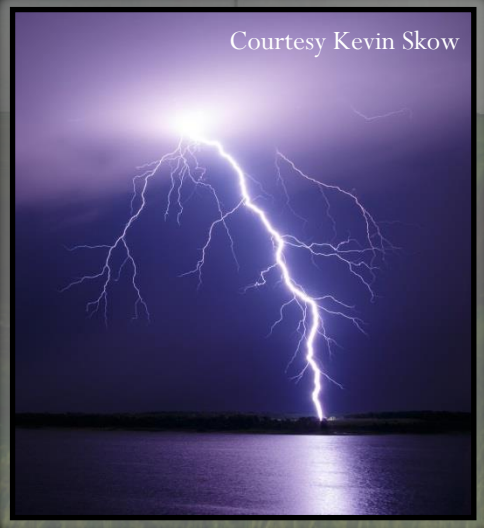
Spotter Safety

Still Not Convinced?

Lightning

Spotter Safety





- Lightning is by far the most common hazard facing spotters
- Be careful on ridge tops and open areas
- Stay in vehicle if mobile

Hear thunder?
You are at risk!

Strong Winds

Spotter Safety

YouTube Video by user mconwxdr

- Frequent with squall lines, but can occur with any type of storm
- Often on the storm's leading edge
  - However, can travel far from the actual storm
- **Do not** seek shelter under trees or in small structures that might collapse!

Hail

Spotter Safety

- Hail can fall at speeds of over **100 mph**!
- Even small hail can cause damage and injury
- Take shelter in a walled structure and stay away from windows
- Wind-driven hail is very dangerous and destructive

Flash Flooding

Spotter Safety

- The #1 severe weather-related killer in the US!
- Heavy rainfall combined with saturated soils
- Impacts amplified by terrain or poor drainage (e.g. cities)

Remember:
Turn around, don't drown!

Spotter Safety

Your SAFETY is our #1 concern!

Courtesy Tim Wagner and Mark Schnackenberg

- Keep an eye to the sky
- Prepare for all hazards
- Watch for flooding & lightning
- Drive smart & safely
- **Use common sense**

Remember, the National Weather Service does not "officially" deploy spotters. Spotting is done at one's own risk!

Iowa 2015 Severe Weather

- A quiet start to the season with a late finish
- Multiple rare October, November, and December tornadoes
- Late season flooding
- 8th wettest year on record in Des Moines

Tornado near Rathbun Lake – November 11

Guthrie Center Flooding – June 25

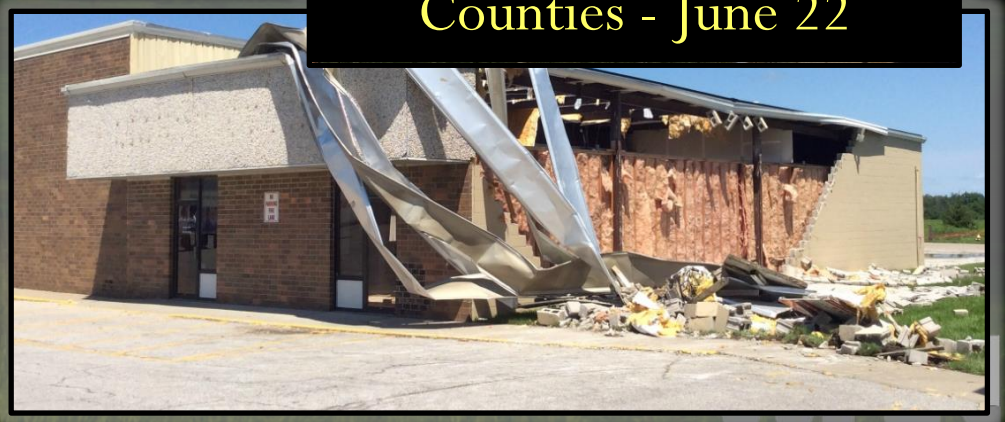
Iowa 2015 Tornadoes

58 tornadoes, 5 injuries, 0 deaths

- May 10: EF1 hits school in Lake City, many homes damaged
- Jun 22: EF3 SE of Columbia, EF-2 in Albia
- Nov 11: EF1 damages Wal-Mart & homes in Knoxville

Lake City
May 10

Marion, Lucas & Monroe Counties - June 22



Iowa 2015 Wind & Hail

A few of Iowa's significant events:

May 17: Long lived high winds across southern and central Iowa. BNSF railcars blown off track

June 20: Giant hail over southeast Iowa. Harvey, IA 3.5" hail.

August 9: Straight line winds across northern Iowa damage a church in Radcliffe

Iowa 2015 Floods

- Above average rainfall over the state
- June flooding along Raccoon River & Des Moines
- Late summer & winter flooding - Wettest December ever

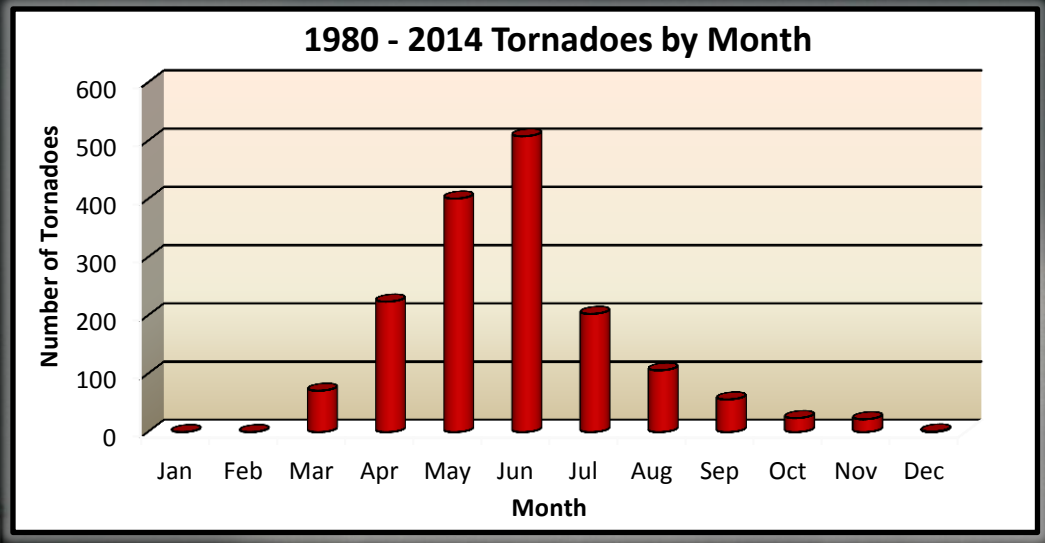
Dayton, IA – Aug 28

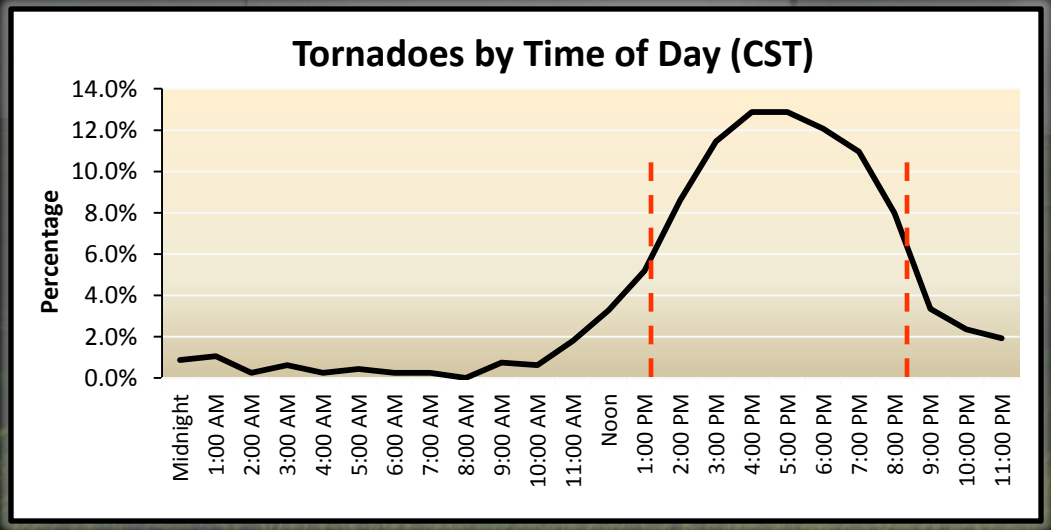
Carlisle, IA – July 28

Iowa Tornado Climatology

By Year:

- Average: 46
- Activity peaks in May and June
- Every month has seen a tornado





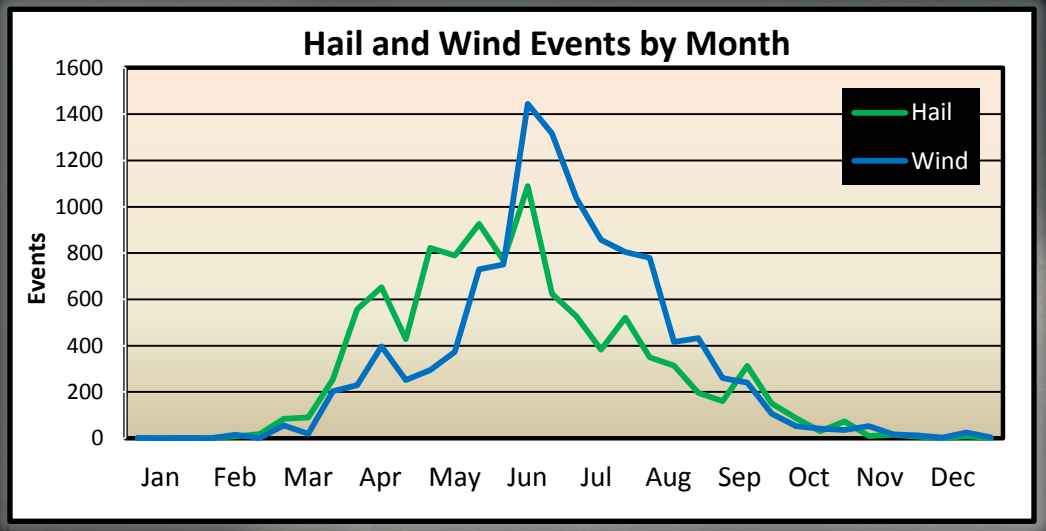
By Time:

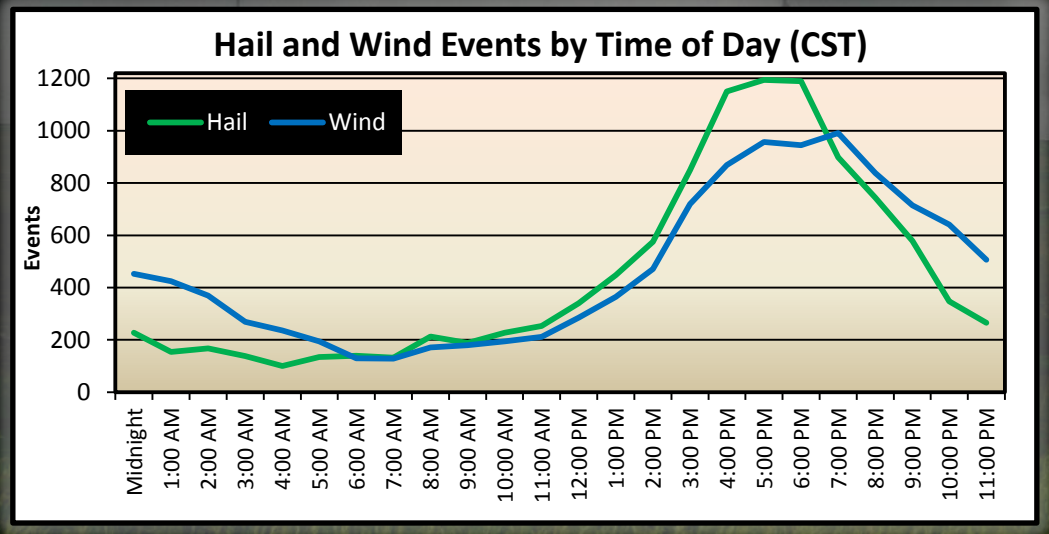
- Most tornadoes occur between 1 & 8 PM
- Minimum at night
- However, can occur at any time of day!

Iowa Hail & Wind Climatology

By Month:

- Peak Threat for Hail:
  Spring – Early Summer
- Peak Threat for Wind:
  Late Spring – Summer
- Occasional events into fall



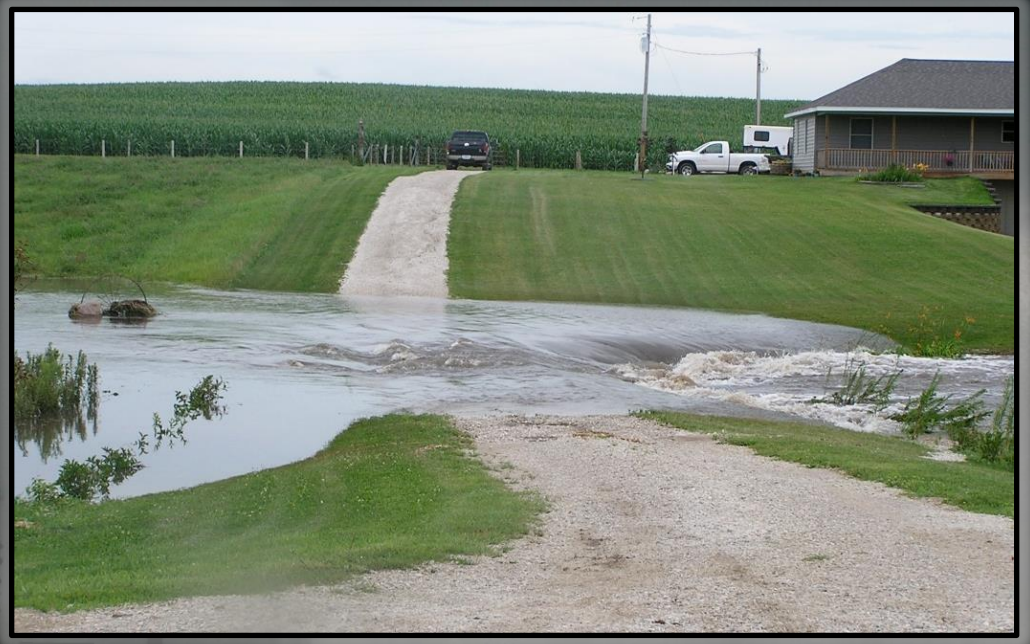


By Time:

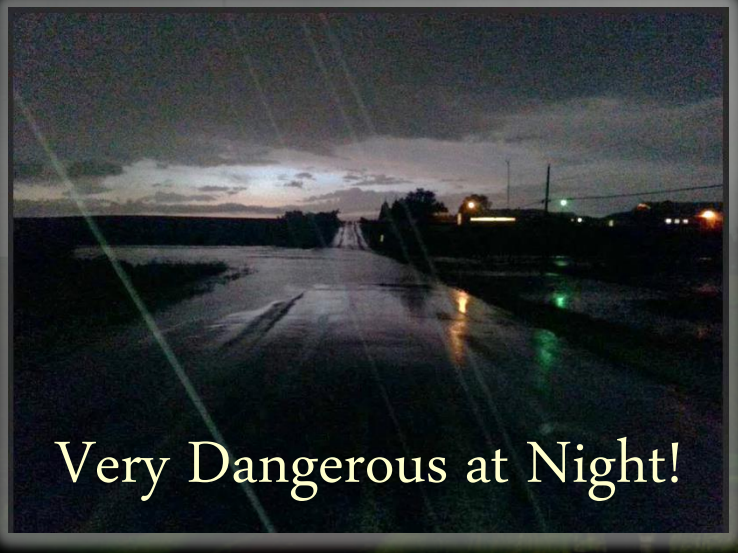
- Peak Time for Hail:
  Afternoon Hours
- Peak Time for Wind:
  Mid Afternoon – Early Morning

Iowa Flash Flood Climatology

- Usually caused by heavy rain (spring/summer)
- Can be caused by ice jams and dam failures



Courtesy Gaylin Crim



Courtesy Russ Wood (Twitter)

Most At Risk:

Low-lying regions/depressions

Areas with poor drainage (e.g. cities)

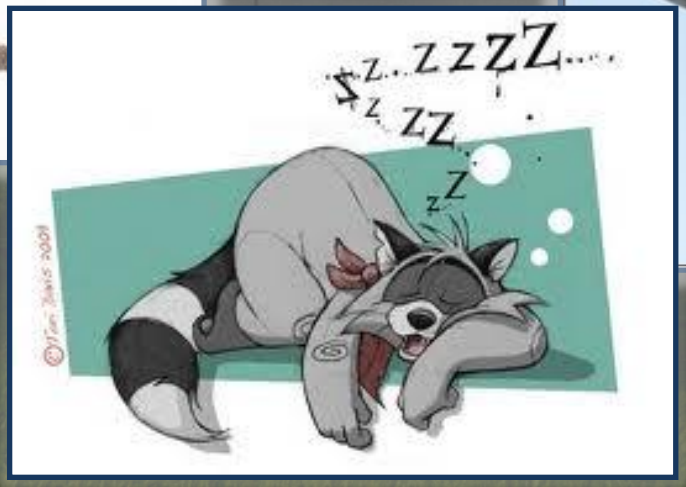
Locations around streams/rivers

BREAK TIME!

~~Part I: Spotter Basics~~

NOW ➡ 10 minute break

Part II: Thunderstorm & Tornado Basics (OPTIONAL)



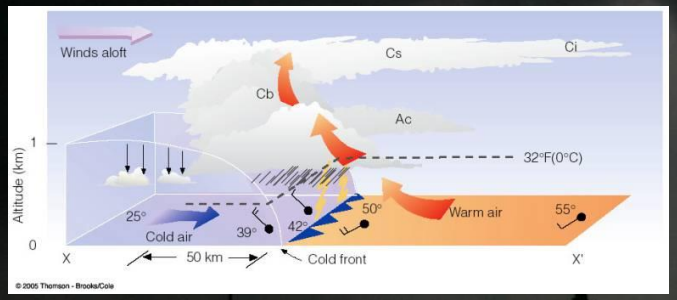
Thunderstorm Fundamentals

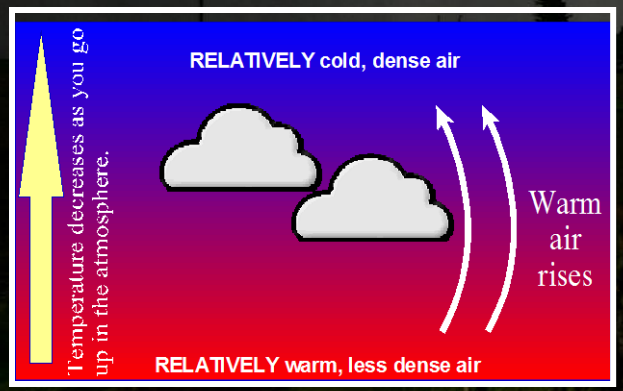
Thunderstorm Ingredients

Thunderstorm Lifecycle

Courtesy Gene Rhoden

Thunderstorm Ingredients

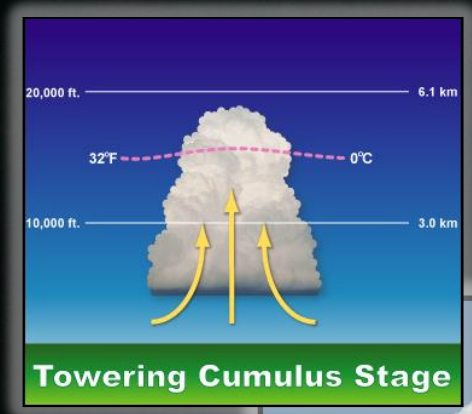


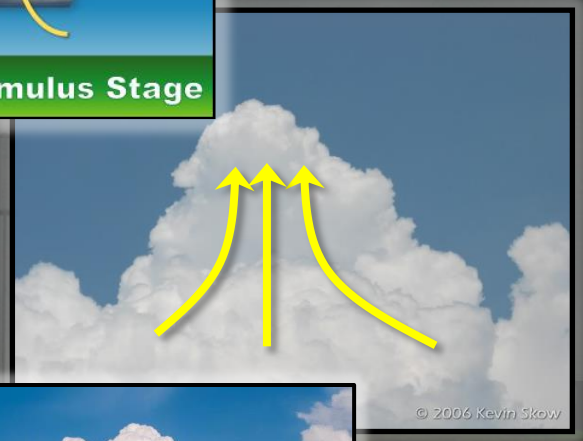


- **Moisture**
  - Forms clouds and precipitation
    - Common source: Gulf of Mexico
- **Lift**
  - Mechanism that forces air to rise
    - Common source: weather fronts
- **Instability**
  - Necessary for a storm's updrafts to grow
    - Example: Warmer (lighter) air under colder (heavier) air

Stage 1: Development Stage

Thunderstorm Lifecycle



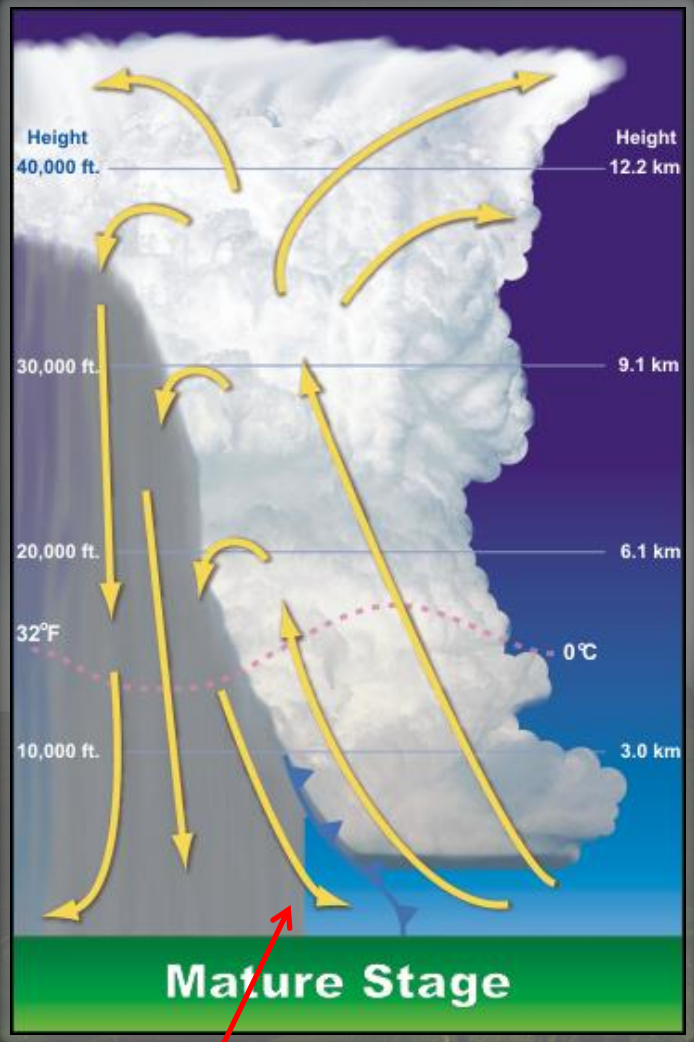


Images Courtesy
Kevin Skow

- Air rises, cools, and condenses into cumulus clouds
- The rising air is known as the storm's **updraft**
- Cloud droplets collide, grow larger, and descend towards the ground
- These falling drops form the storm's **downdraft**, and the storm enters Stage 2

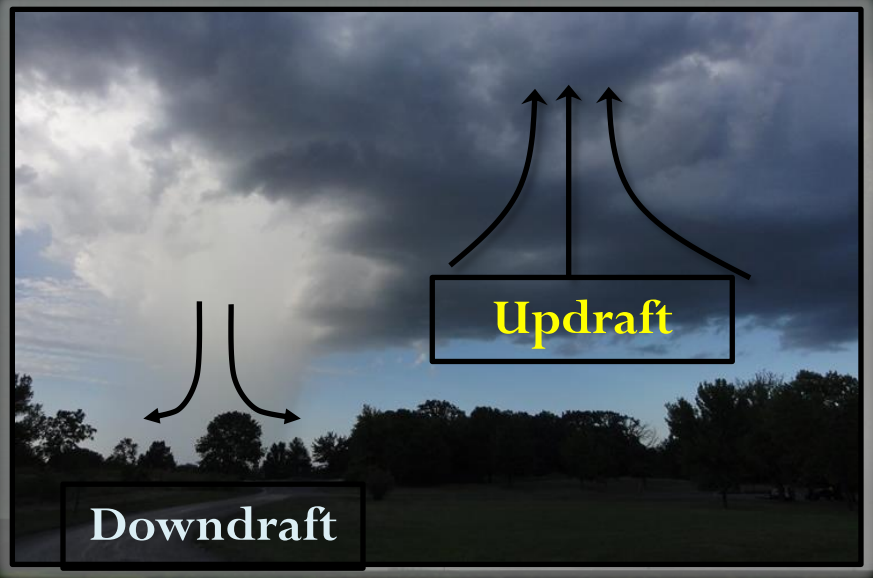
Stage 2: Mature Stage

Thunderstorm Lifecycle



Action Area

Updraft and downdraft coexist

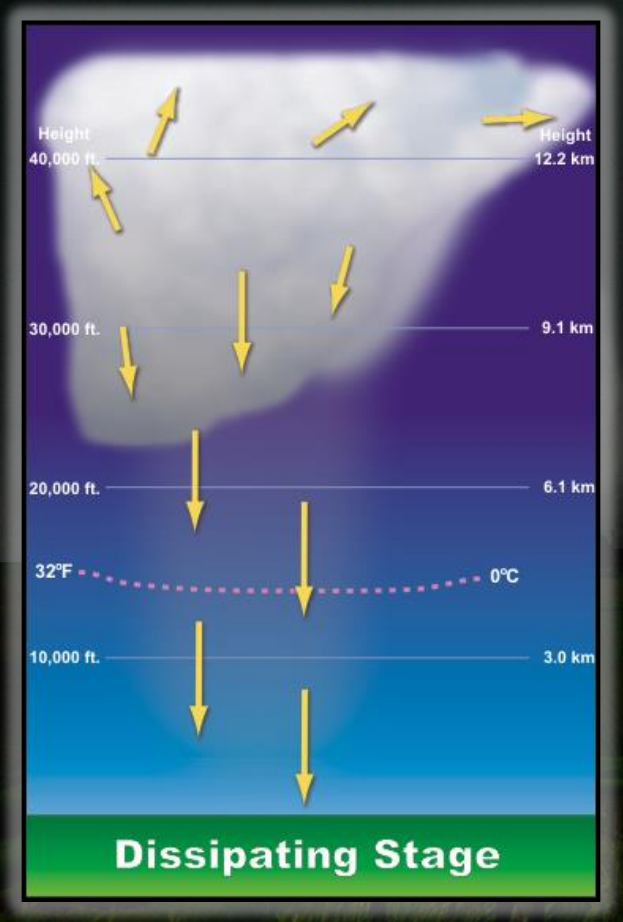


The most important stage since this is when the majority of severe weather occurs

Stage 3: Dissipating Stage

Thunderstorm Lifecycle

Downdraft cuts off the storm updraft, storm begins to dissipate



Courtesy Kevin Skow

Severe weather threat decreases rapidly in this stage

Lifecycle Time-Lapse Video

Courtesy of the Iowa Environmental Mesonet

A thunderstorm undergoing all three lifecycle stages

This storm lasted about 40 minutes

Updrafts and Downdrafts

- Rotating Updrafts (Supercells)
- Updraft and Downdraft Locations
  - Rear/Southern Flank Updrafts
  - Front/Leading Edge

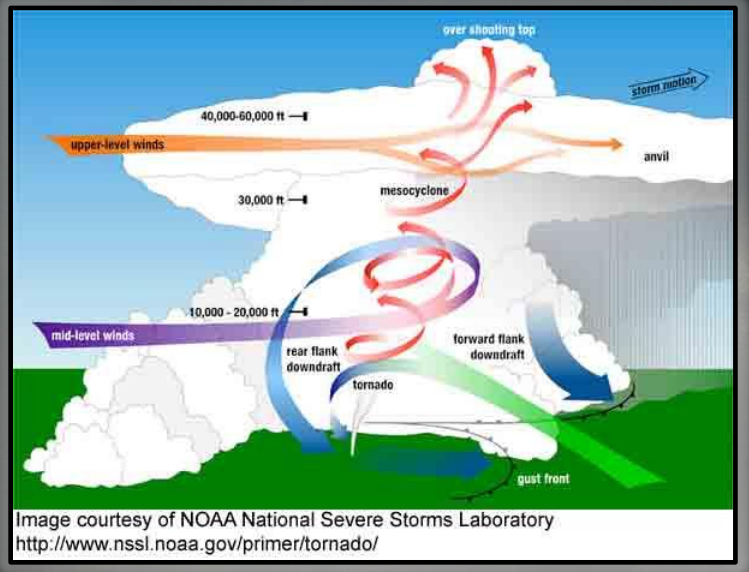
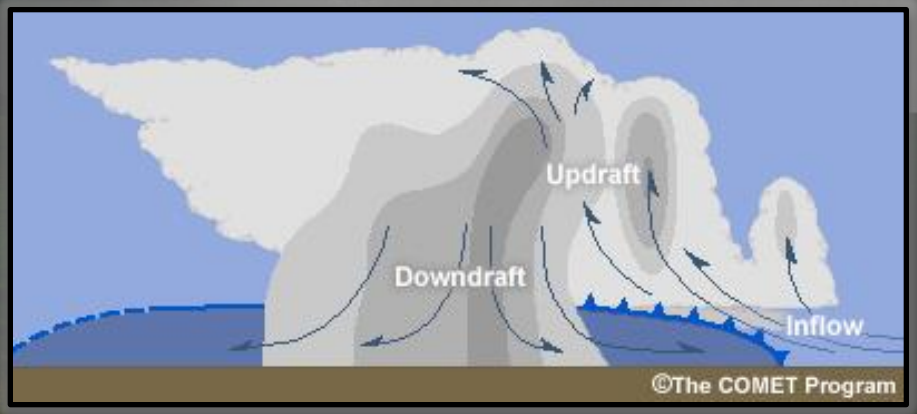


Image courtesy of NOAA National Severe Storms Laboratory
http://www.nssl.noaa.gov/primer/tornado/



Rotating Updrafts/Supercells

Courtesy of Roger Hill

An often dangerous storm consisting of a single, quasi-steady **rotating** updraft typically lasting longer than 10 to 20 minutes.

Can be in the rear or front of the storm

Rotating updrafts/supercells can lead to the production of very large (2+ inch) hail and violent (EF2-EF5) tornadoes.

Updraft/Downdraft Locations

Spotters need to identify updraft and downdraft locations. Updrafts can essentially be grouped into two basic areas.

Rear Flank Updrafts

Courtesy Rob Koppert

Discrete Cells

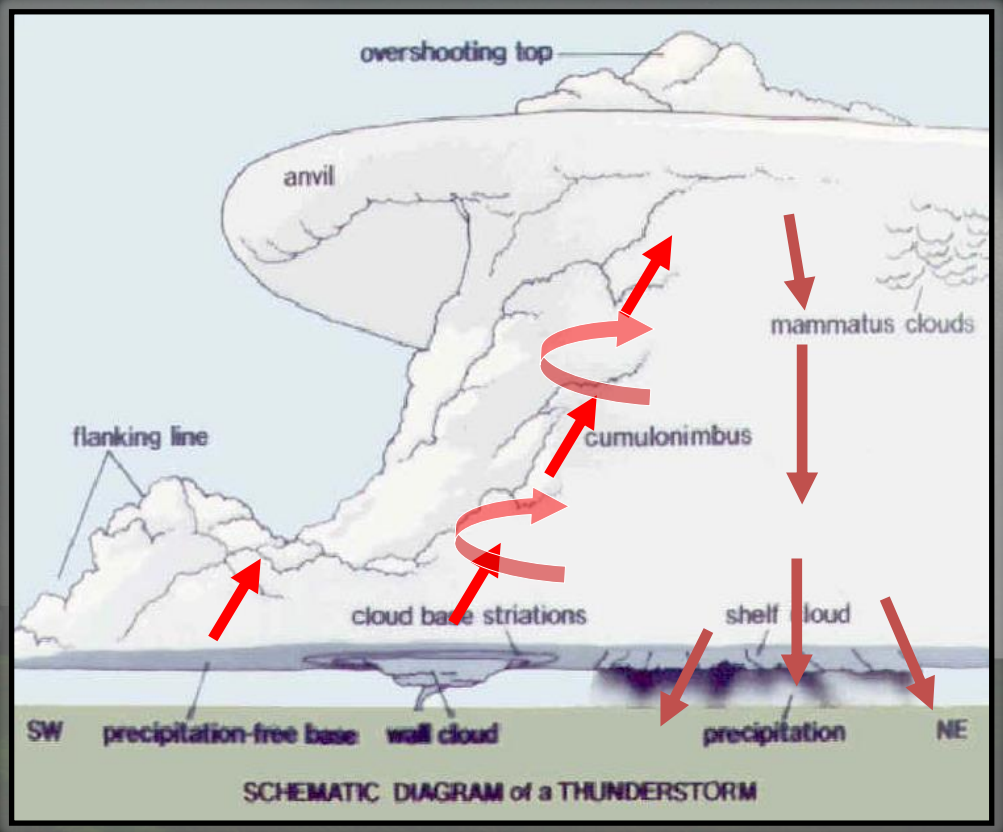
Front Flank Updrafts

Courtesy Kevin Skow

Multi-cells/Squall Lines

Rear/Southern Updrafts

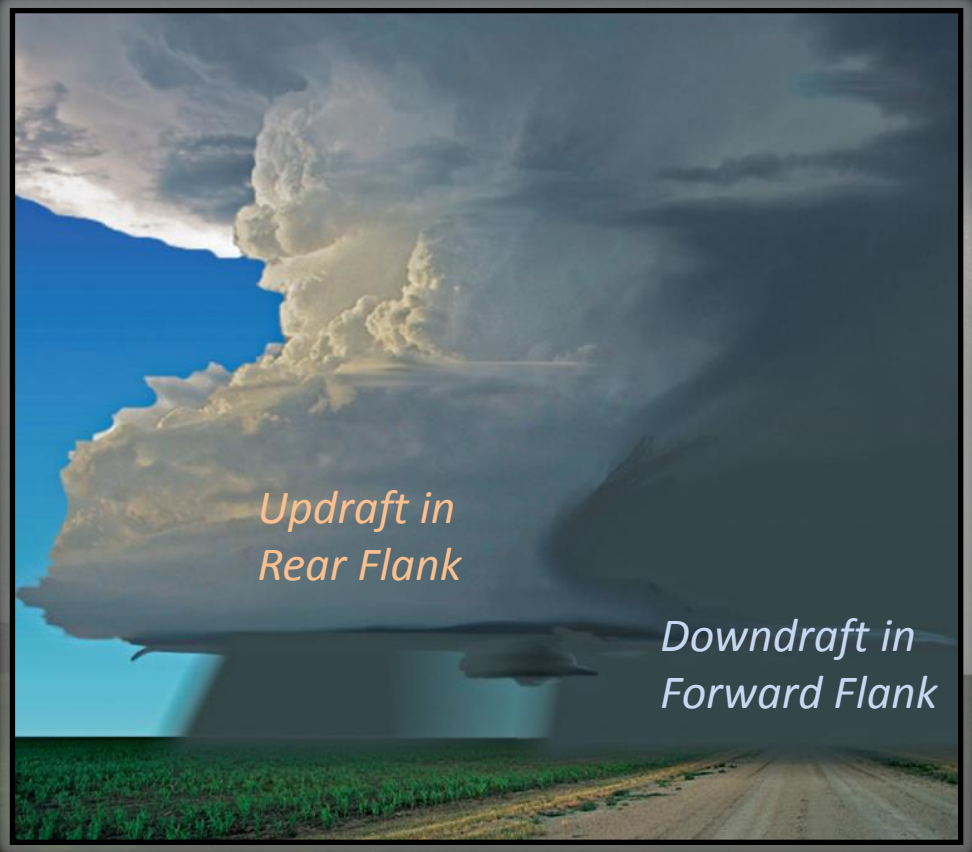
- Typically more discrete or isolated cells
- Storm can be slow or fast moving
- Downdraft toward the front of the storm
- Updrafts can be rotating (Supercell)



Storm Motion

Rear/Southern Updrafts

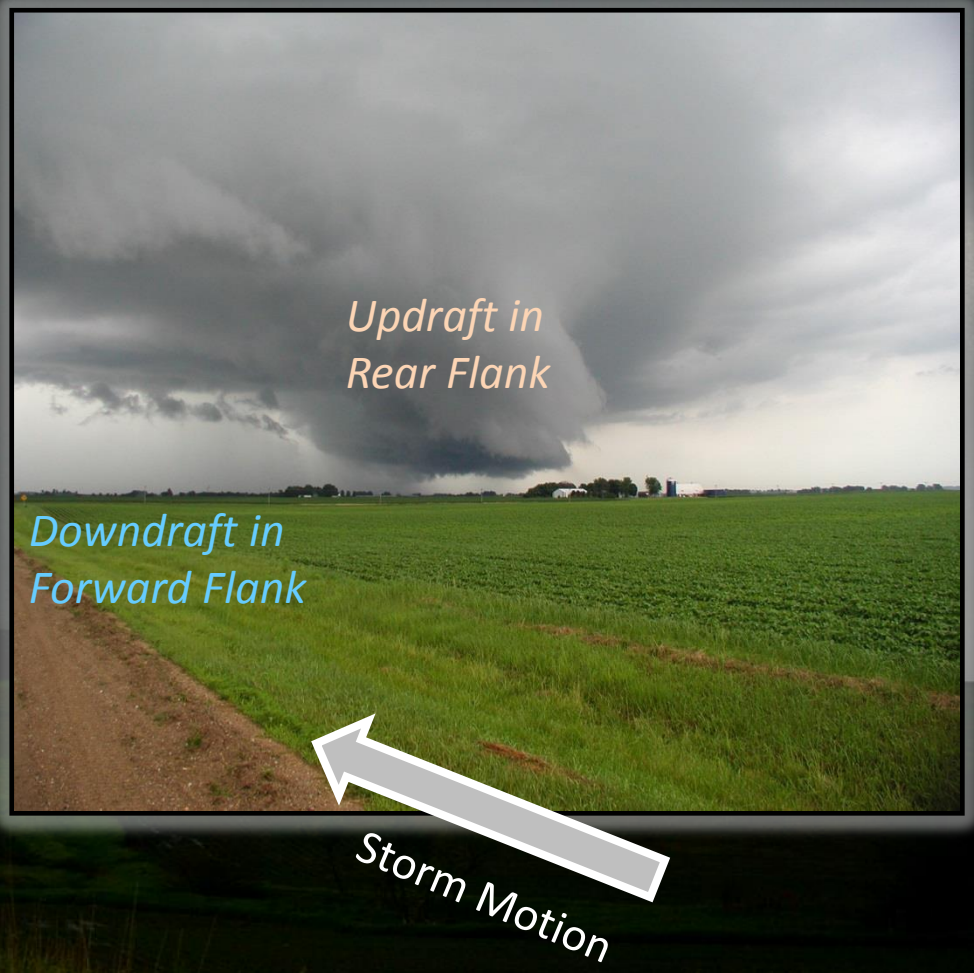
- Large, flat updraft base
- Heavy rain in the forward region of the storm
- Large hail possible near updraft/downdraft interface
- Updraft tower often more readily apparent



Movement Left to Right

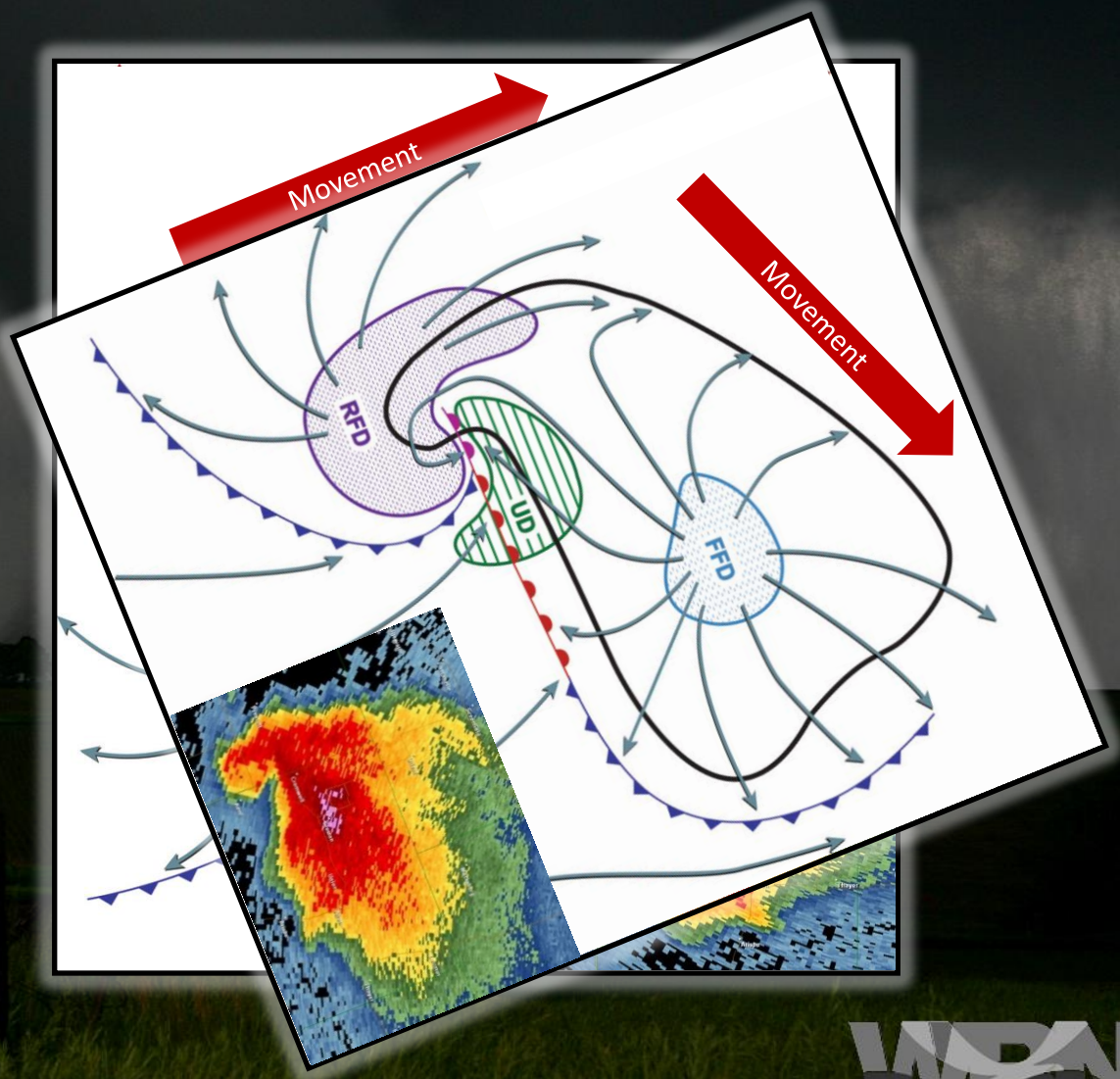
Rear/Southern Updrafts

- Large, flat updraft base
- Heavy rain in the forward region of the storm
- Large hail possible near updraft/downdraft interface
- Updraft tower often more readily apparent



Rear/Southern Updrafts

- Rear flank is often on the south, but <u>rear</u> portion is the emphasis.
- The storm could be moving towards the southeast, northwest, or anywhere in between!

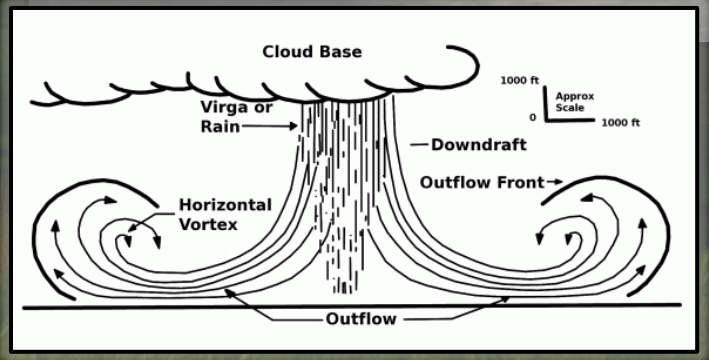


Leading Downdraft

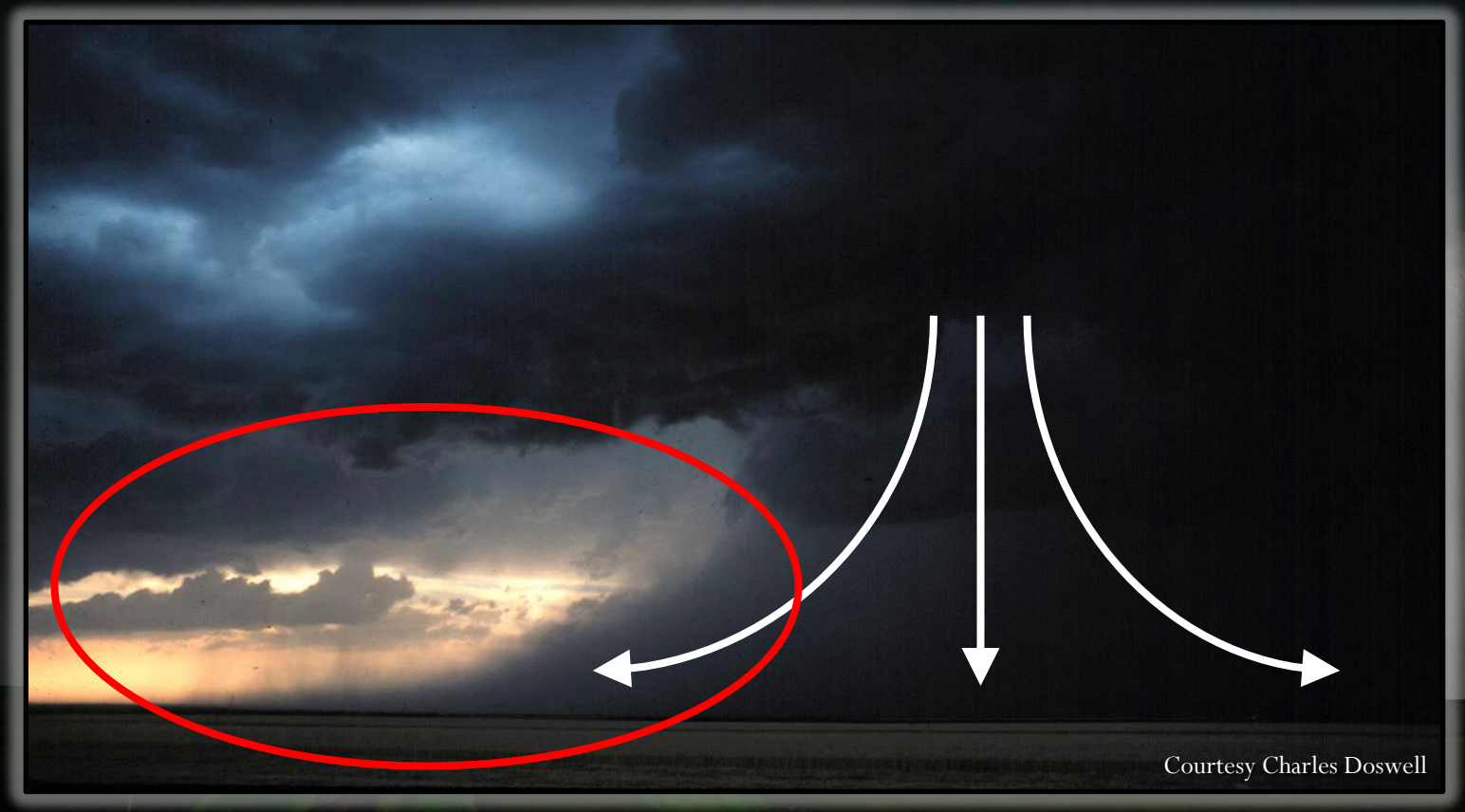
- Even weak storms can produce localized damaging winds called a microburst.
- Caused by a leading, small-scale downdraft that hits the ground and spreads outward.
- Winds can exceed 80 mph.
- Only a few square miles in size. Lasts ≈ 5 mins.
- Difficult to detect on radar.

Lake Panorama – September 10, 2013

Courtesy Iowa Environmental Mesonet



Signs of a Microburst



Rain Foot

A pronounced outward deflection of the precipitation near the ground

Forward Flank Updrafts

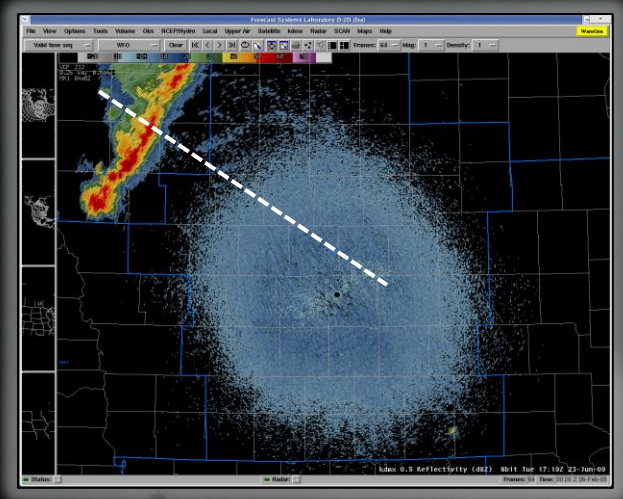
Squall Line

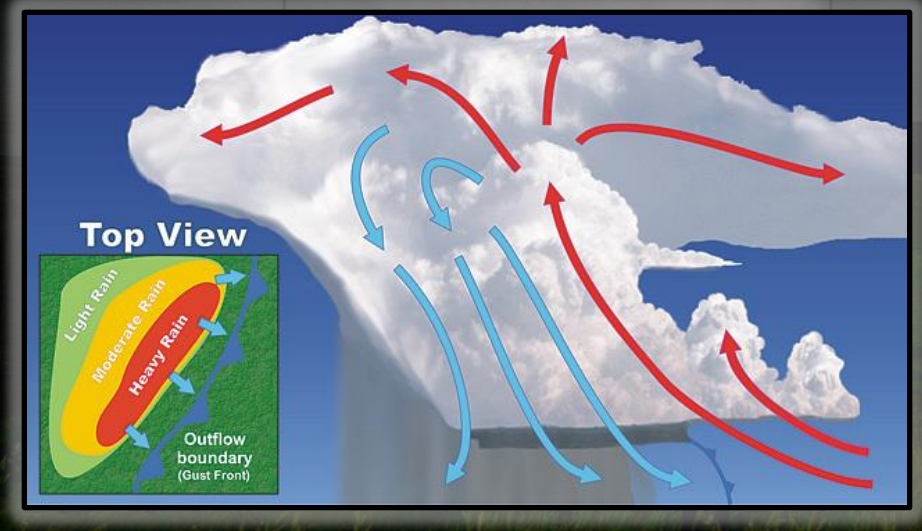
HP Supercell

Courtesy Winston Wells

Squall Lines

Forward Flank Updrafts





Squall Line Cross Section

- A "line" of storms where the individual downdrafts merge together, also known as a **squall line**
- The leading edge of this continuous downdraft is called the **gust front**
- The gust front produces a signature cloud known as a **shelf cloud**
- Typically form along frontal boundaries

Squall Lines

Forward Flank Updrafts

Shelf Cloud

Courtesy Ken Podrazik

- Often associated with squall lines, but can occur with individual storms regardless of updraft position.
- Located on the leading edge of the line, or near gust front. Updraft above.
- Long, flat cloud which slopes down from the rain

No Vertical Rotation

Time Lapse of a Squall Line

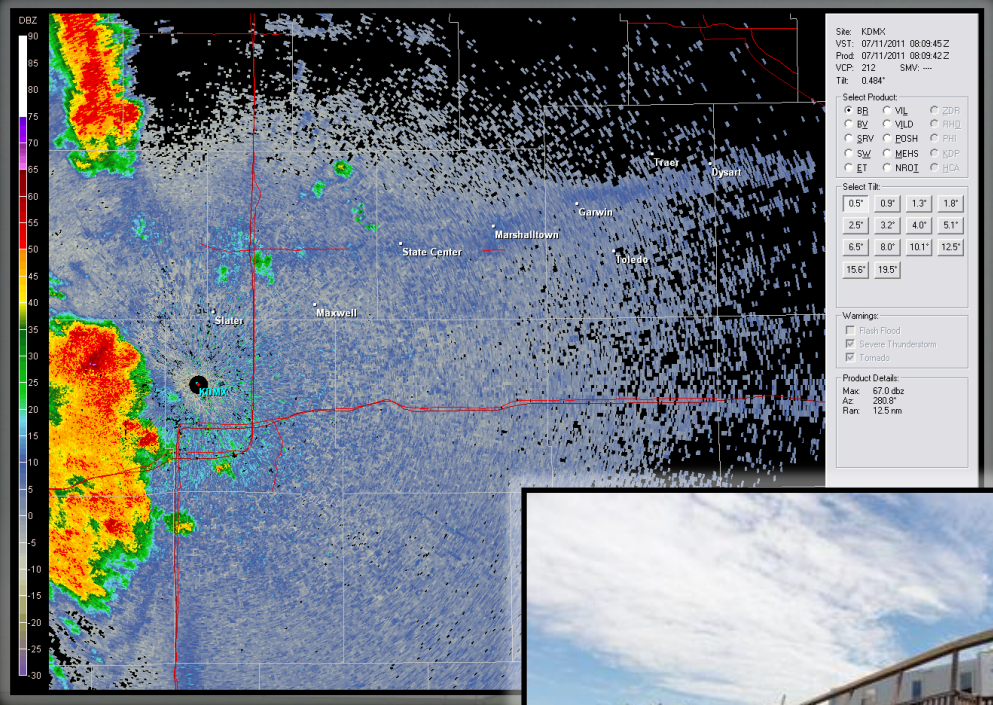
Forward Flank Updrafts

Courtesy Iowa Environmental Mesonet

Note the approaching shelf cloud and how the wind rapidly increases as the gust front (downdraft) moves through

Squall Line Hazards

Forward Flank Updrafts



East Iowa Derecho
July 11, 2011

Widespread Damaging Winds

- Moderate sized hail
- Heavy rain
- Occasional tornadoes

Forward Flank Updrafts

HP Supercell

- Rotating updraft on the front of the storm
- Heavy rain often obscures wall clouds and tornadoes
- Common in Iowa!

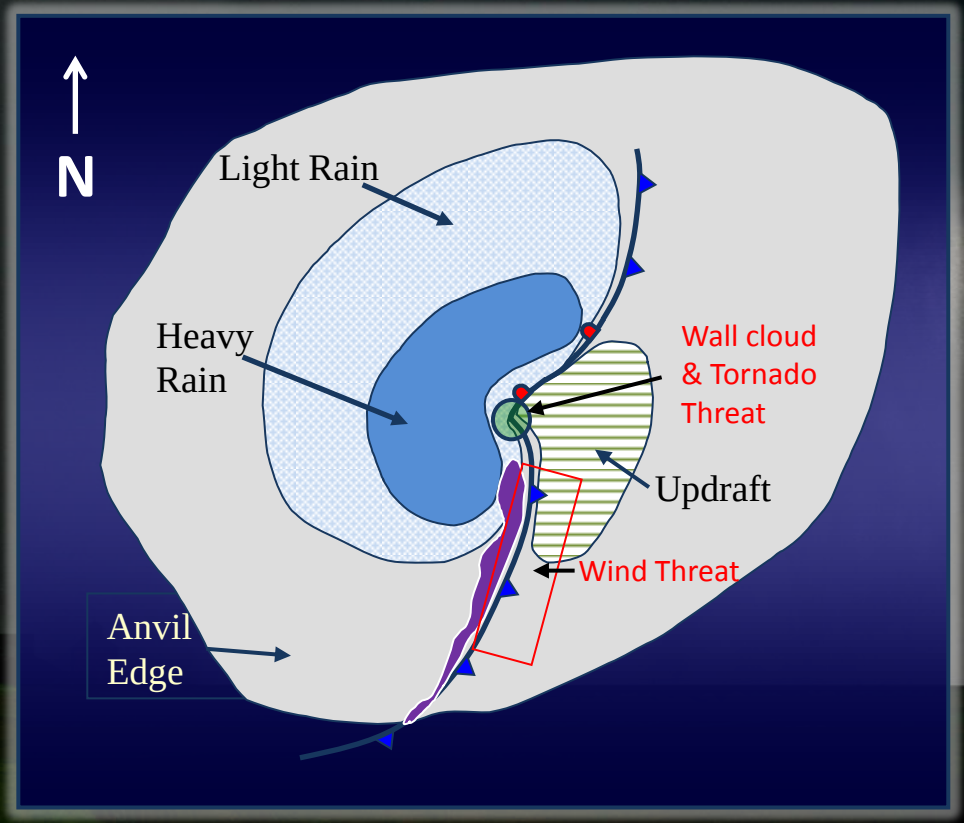
Artist Rendition of the Front of an HP Supercell

High Precipitation Supercells

Forward Flank Updrafts

- Large update in front of storm
- May have a shelf cloud along the gust front
- Extremely heavy rain may cause flash flooding
- Tornadoes may be hidden in the rain

HP Supercells can often transition to squall lines



High Precipitation Supercell Diagram

High Precipitation Supercells

Forward Flank Updrafts

Courtesy of Tim Jones

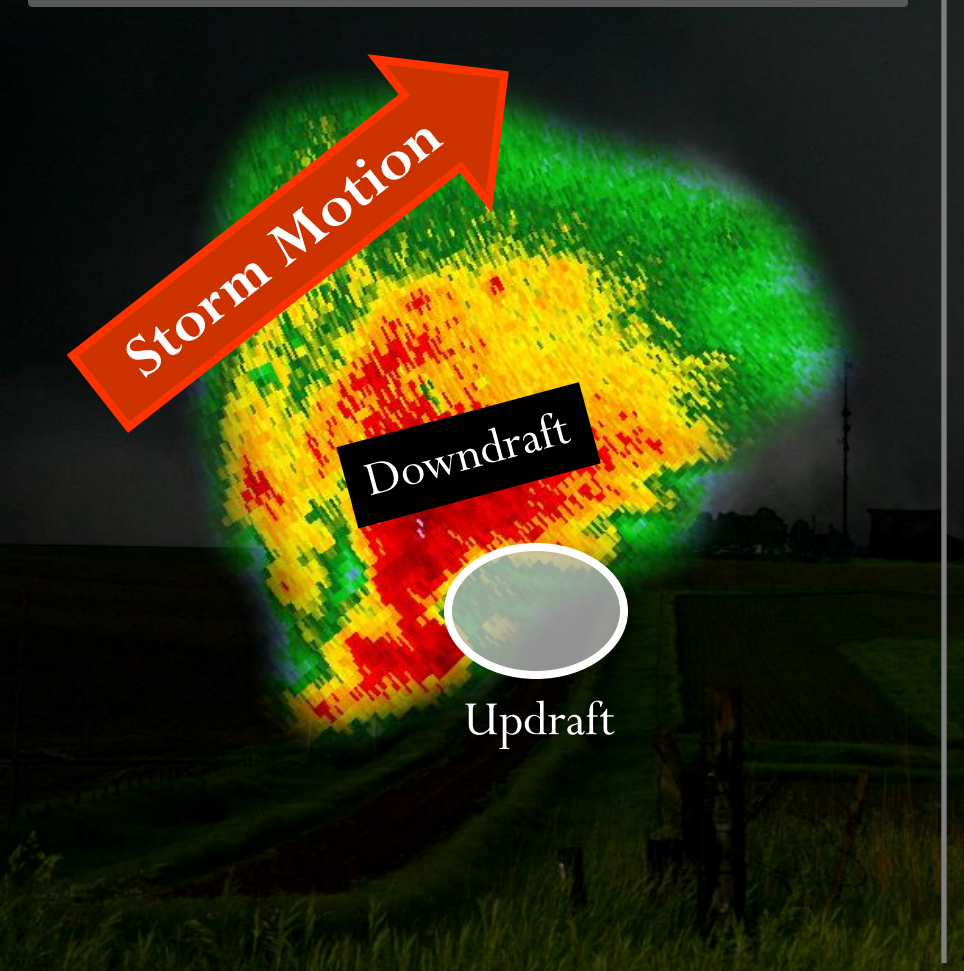
Courtesy of Al Moller

Note the Shelf Cloud along the Gust Front

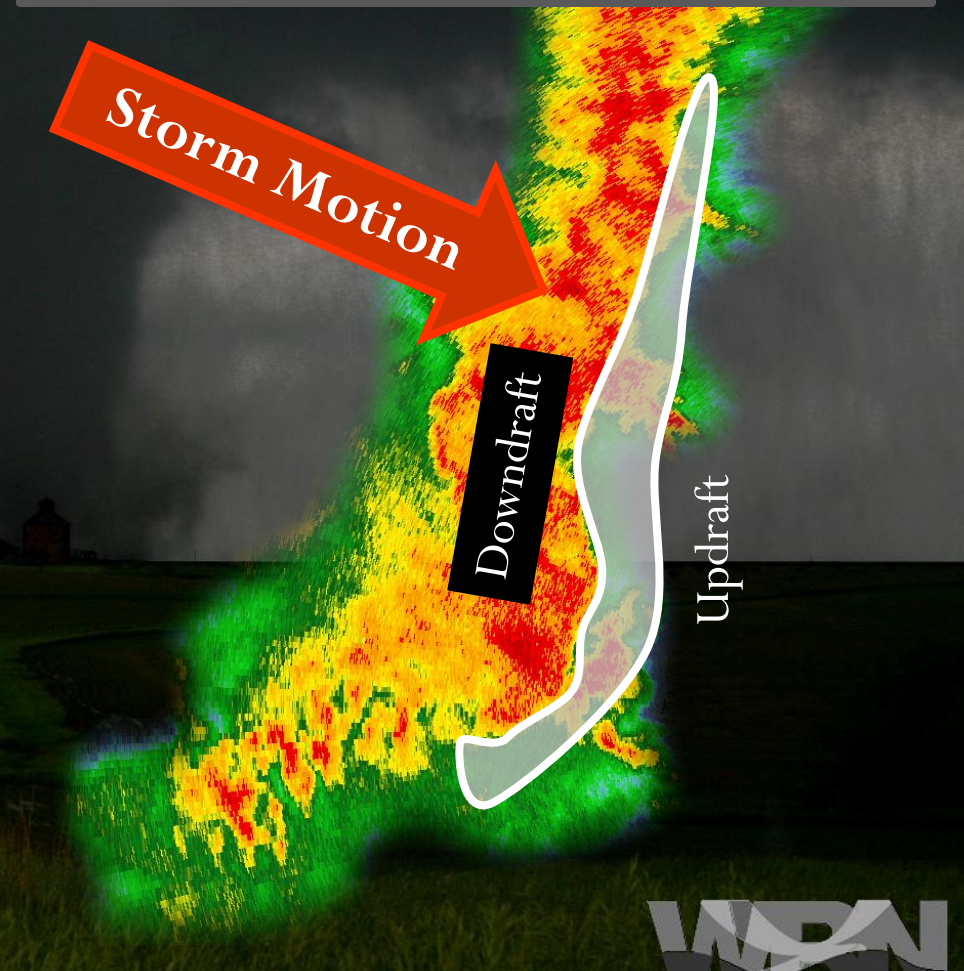
High Precipitation Supercell Examples

Updraft/Downdraft Summary

Rear Flank Updraft



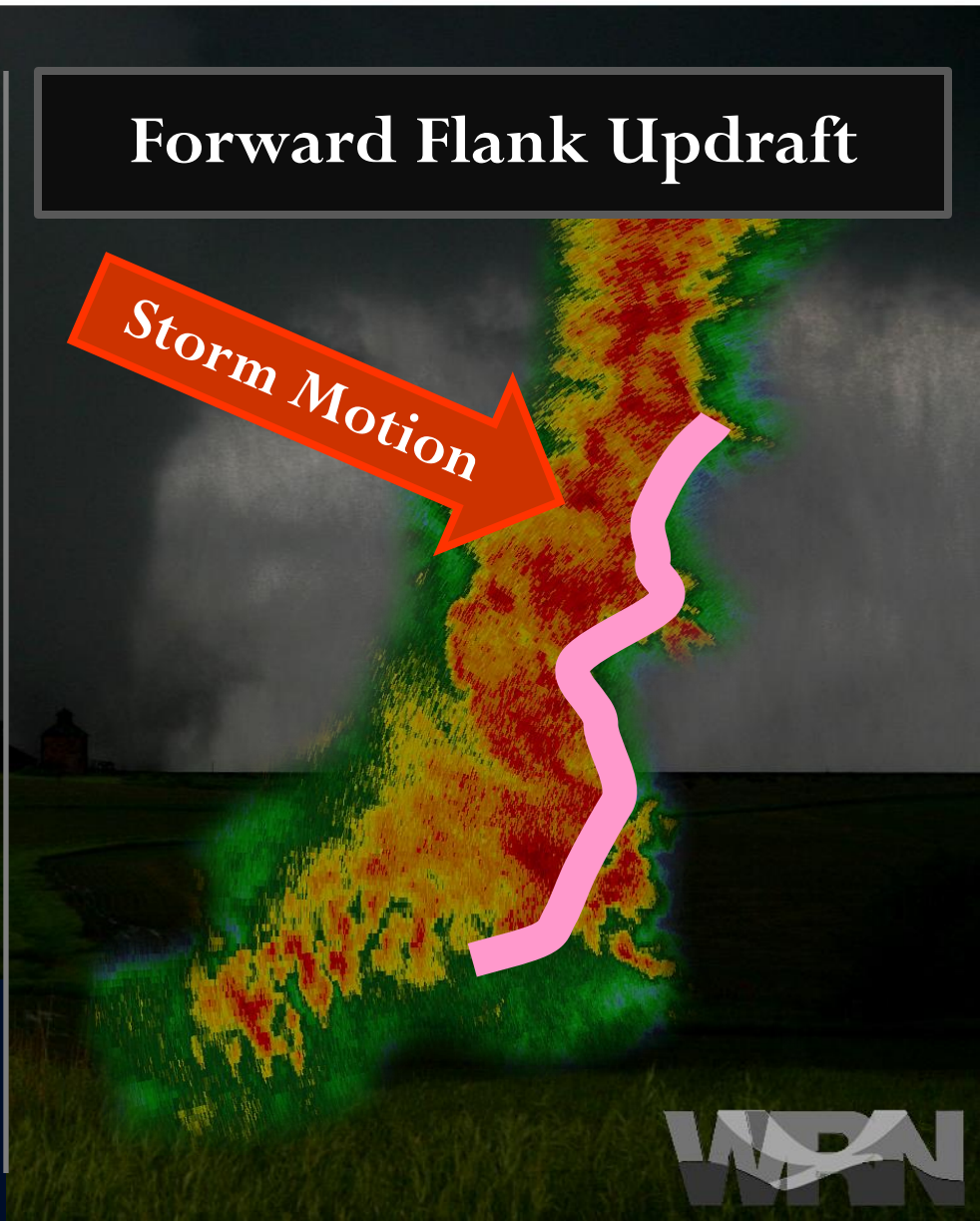
Forward Flank Updraft



Updraft/Downdraft Summary

Rear Flank Updraft

Forward Flank Updraft



Hazard Zone:
Tornadoes, Wind & Hail

Wall Clouds

Features of Strong & Severe Storms

Courtesy of Kevin Skow

Isolated cloud attached to the bottom of the updraft

Can be associated with both severe and non-severe storms

Wall Clouds

Features of Strong & Severe Storms

Courtesy of WOI-TV

Signs of a Severe Wall Cloud

- Visible rotation and rising motion into the cloud
- Lasts for at least 10 minutes
- Strong winds rushing towards the wall cloud

Funnel Clouds

Features of Strong & Severe Storms

- Narrow, tube-like cloud extending down from the base of a storm or wall cloud
- **Will be rotating**
  - Often smooth in appearance
- If the funnel circulation comes in contact with the ground, it becomes a tornado
  - Look below the funnel for swirling dust or debris as a tipoff that it has become a tornado

Tornadoes

Lifecycle

Locations in Storms

Variations

Falsenadoes

"A violently rotating column of air attached to a nearby shower or thunderstorm and in contact with the ground. A visible cloud or appearance of funnel is not needed.

Twitter Photo by Luke Holman

Stage 1: Development Stage

Tornado Lifecycle

Connection of dust whirl to a rotating wall cloud, a funnel cloud, or cloud base

Stage 2: Mature Stage

Tornado Lifecycle

Widening funnel, vertically orientated

Funnel often extends completely to the ground

Tornado is likely at its strongest in this stage!

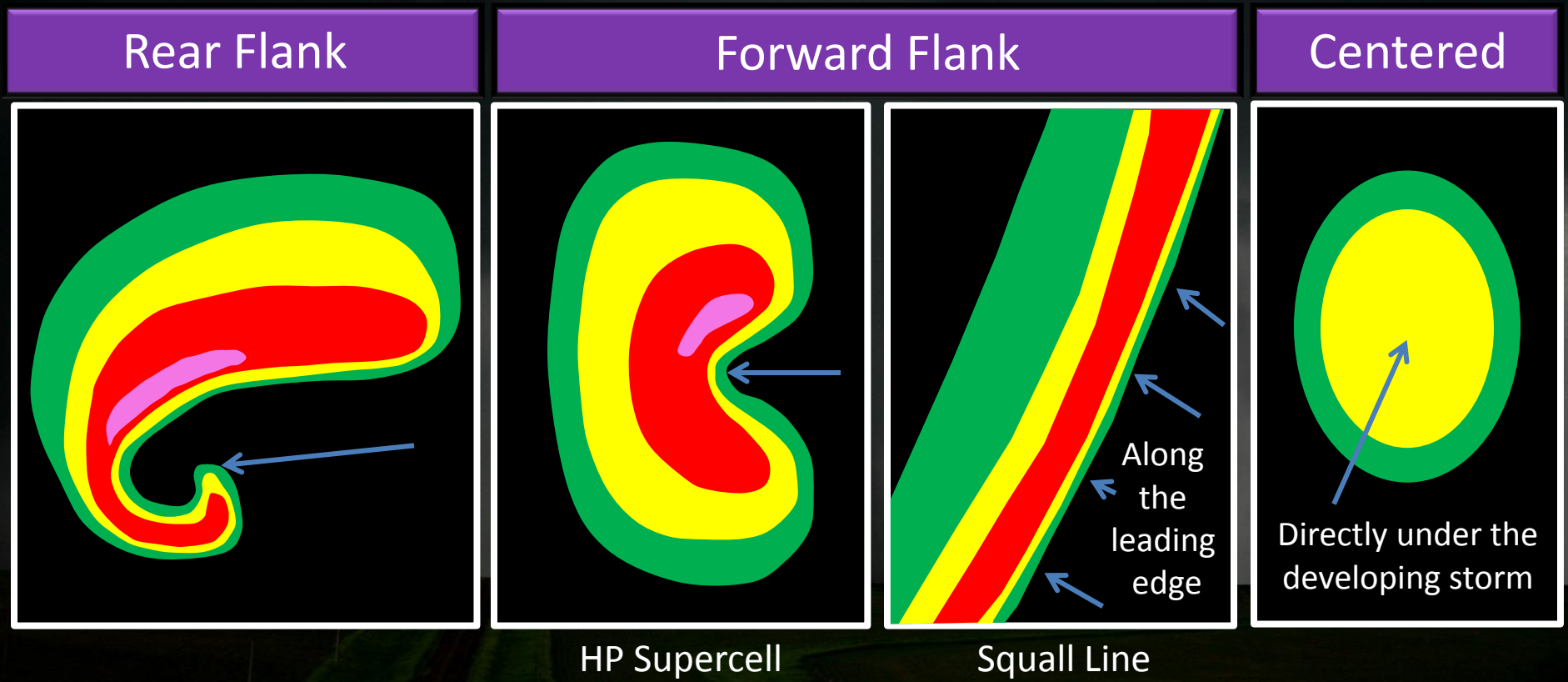
Stage 3: Dissipating Stage

Tornado Lifecycle

The funnel becomes a thin rope and then dissipates.

The tornado may still be very dangerous at this stage!

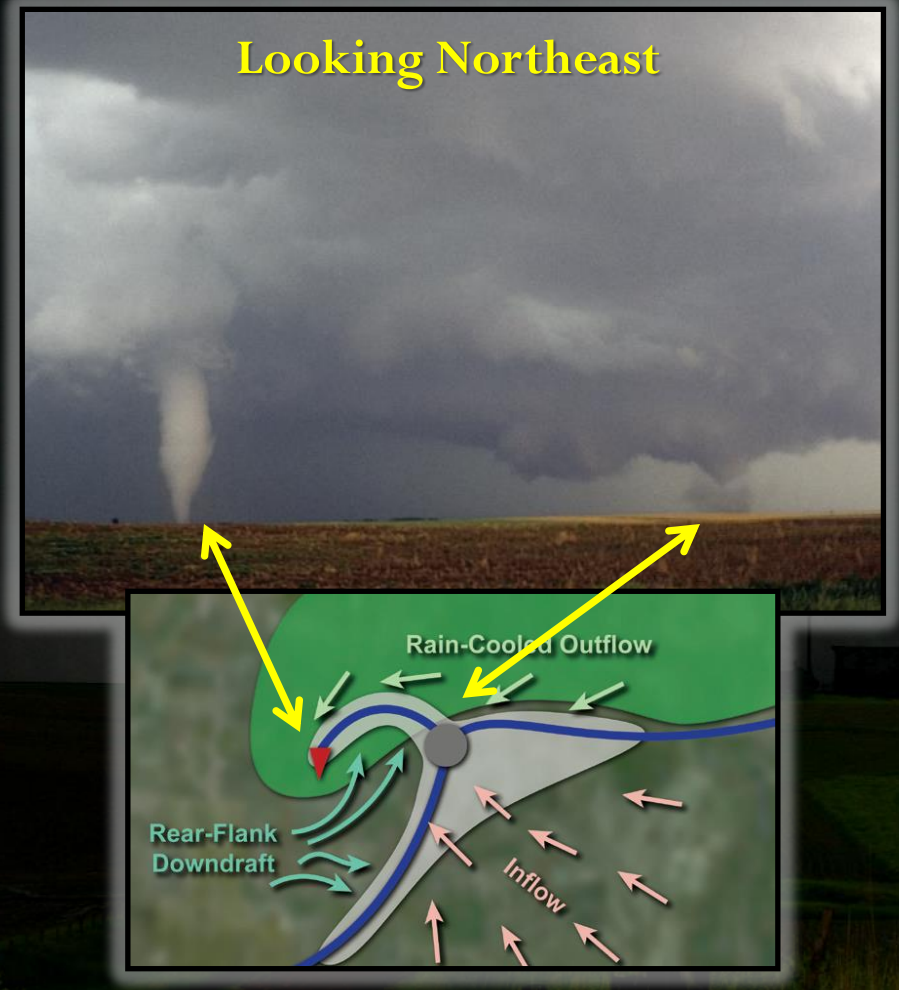
Tornado Locations in Storms



Bottom Line: Tornadoes can form in various locations, depending on the storm type

Supercell Tornadoes

Tornado Locations in Storms



"Cyclic" Supercells

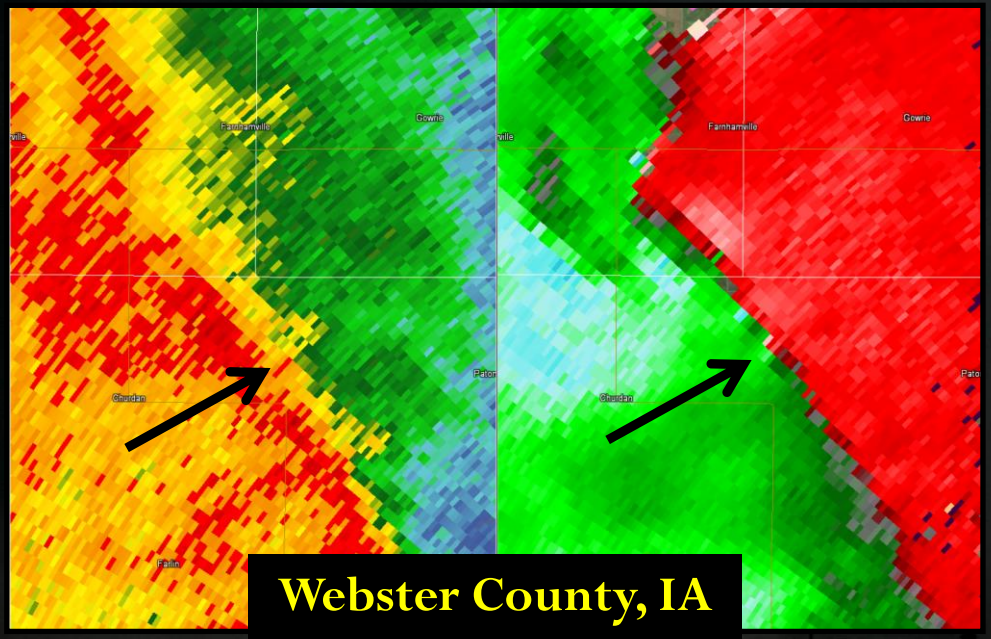
- Special form of supercell that can produce more than one tornado at a time
- As old tornado weakens and dies, a new tornado forms out ahead of it. Gradual transition from rear to more forward flank

Hampton, IA
June 12, 2013

Courtesy KCCI uLocal

Multi-Cell Line Tornadoes

Tornado Locations in Storms



Webster County, IA
August 31, 2014

- Tornadoes can form at the leading edge of squall lines (along the gust front)
- Often short-lived, but can still be damaging
- Tornadoes are rain-wrapped in many cases
- Can form very quickly and be difficult to detect on radar!

Single Cell Tornadoes

Tornado Locations in Storms

- Tornadoes with these storms are known as **landspouts**
- Form in the developmental phase of thunderstorms

Characteristics

- Little precipitation, no wall cloud, usually a thin funnel
- "Waterspouts over land"

Often impossible to detect on radar!

Tornado Variations

Courtesy Rod Donavon

Wedge Tornado

New Hartford, IA 2008

Courtesy KCCI uLocal

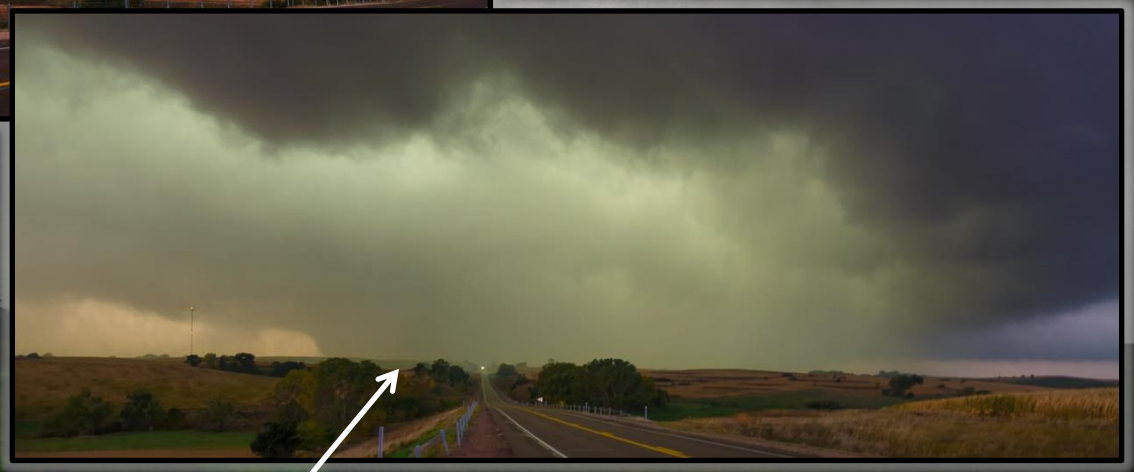
Cone-Shaped Tornado

Reinbeck, IA 2014

Wedge tornadoes tend to be intense. However, the strength of a tornado cannot be determined by observation!

Rain-Wrapped Tornadoes

Tornado Variations



Photos Courtesy Kevin Skow

Moville, IA
October 4, 2013

Rain-wrapped tornadoes are often associated with HP supercells and squall lines

Invisible Tornadoes

Tornado Variations

Courtesy Storm and Sky

Tornadoes do not always have a visible funnel!

Falsenadoes

Gustnadoes
Scud Clouds
Shelf Clouds
Dust Devils
Rain Shafts
Smoke Plumes
Towers
Grain Elevators

Nope, just a scud cloud

Gustnadoes

Falsenadoes

- Swirl of dust at the ground along the edge of a gust front
- Caused by winds surging out from a storm and is **NOT** connected to the cloud base, unlike a tornado
- Winds in a gustnado can still be strong and damaging

Gustnado or Tornado?

Falsenadoes

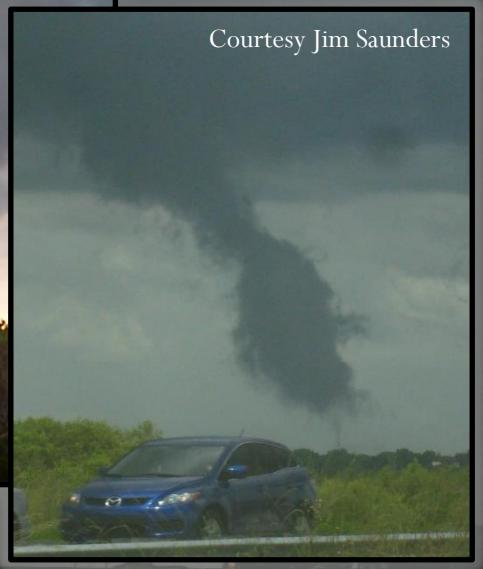
The answer is not always clear cut!

Both tornadoes and gustnadoes can form at the leading edge of a storm

To tell the difference, **look at the clouds above the dust swirl**. If they are rotating as well, then you likely have a tornado.

Scud Clouds

Falsenadoes

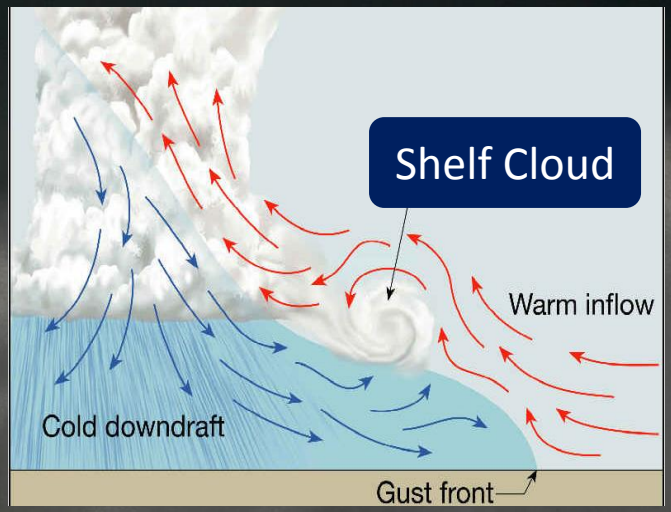


- Ragged clouds on the underside of a storm that are **NOT** attached to the main storm base
- Can resemble wall clouds, funnel clouds, and tornadoes
- Often short-lived and **do not** exhibit vertical rotation

Shelf Clouds

Falsenadoes

Photos Courtesy Kevin Skow



- Long, flat cloud along the front of a storm (resembles a shelf)
- When viewed from up-close or at night, can be mistaken for a funnel cloud
- Rotates in the **horizontal**, but not the vertical!

Dust Devils

Falsenadoes

Courtesy Bryant Eakins

Courtesy Joshua Jergens

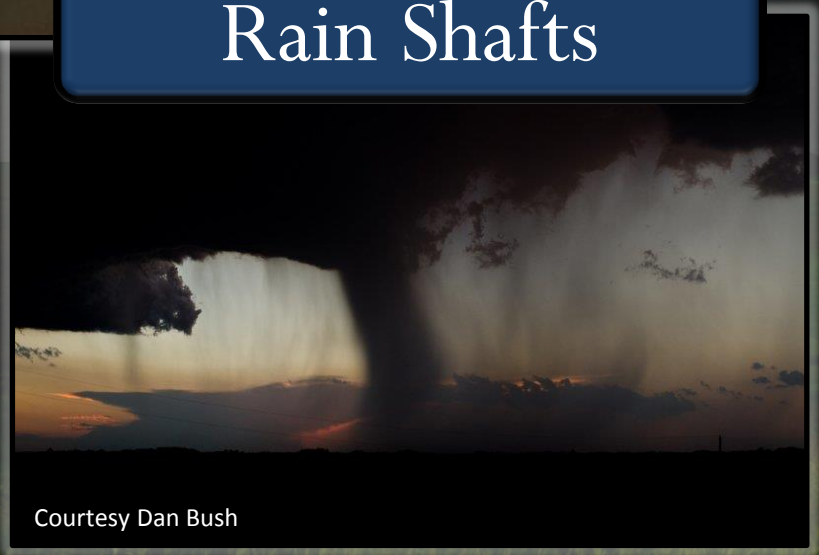
- Form on hot, sunny, summer days with light winds
- Can extend several hundred feet into the sky
- Winds are usually light and don't cause any damage

Rain Shafts & Smoke Plumes

Falsenadoes

Courtesy Andrew Revering

Rain Shafts



Courtesy Dan Bush

Smoke Plumes

http://australiasevereweather.com

Tornado Spotting Tips

Falsenadoes

If you are unsure:

Watch the feature for a few minutes and ask, "Is it…

- Rotating about a vertical axis?
- Attached to the cloud base?
- In the right location in the storm?
- Lofting debris or dust?

Courtesy NZP Chasers

If you answer "no" to any of these questions, then it is probably NOT a tornado!

Quiz

Wall Cloud or Shelf Cloud?

Funnel Cloud?

Tornado?

Scud Cloud?

Identify the features

Quiz

You Make The Call!

1. **Tornado**
2. **Downburst**
3. **Rain shaft**
4. **Gustnado**

Courtesy Whitey Anderson

It is tough to determine in real-time. Looping the video reveals weak rotation in the clouds above the dust swirl.

Quiz

You Make The Call!

1. Tornado
2. Downburst
3. Rain shaft
4. Gustnado

Courtesy Willard Sharp

Rain-wrapped tornado. Lower portion of funnel is invisible.

Video taken on November 11, 2015 West of Winterset

Quiz

Scud Cloud or Tornado?

Shelf Cloud or Tornado?

Identify the features

Quiz

You Make The Call!

1. Tornado

2. Funnel Cloud

3. Rain shaft

4. I have NO IDEA!!

Courtesy Bob Lorraine

Quiz

You Make The Call!

1. Tornado
2. Funnel Cloud
3. Rain shaft
4. I have NO IDEA!!

Courtesy Bob Lorraine

Quiz

Courtesy Willard Sharp

Wall Cloud or Shelf Cloud?

Courtesy Willard Sharp

How many Tornadoes?

Identify the features

Conclusion

What this Training Provided:

- Knowledge about how to spot severe weather and communicate what is seen to the NWS
- Awareness about the inherent dangers associated with severe weather spotting
- An understanding that the NWS does not officially deploy spotters and that spotters deploy at their own risk!

Conclusion

What this Training ***Did Not*** Provide:

- Any official certification – being a spotter is voluntary
- A license to break any law, **including traffic laws**!
- Any official affiliation as a National Weather Service agent or employee

The End!

Thank you for Attending
Have a SAFE year!